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An EXACT
SURVEY
OF THE
TIDE.

Explicating its
PRODUCTION and PROPAGATION,
VARIETY and ANOMALY,
In all Parts of the WORLD;
Eſpecially near the
Coaſts of *GREAT BRITAIN*
and *IRELAND*.
With a Preliminary TREATISE concerning
the Origin of SPRINGS, Generation of
RAIN, and Production of WIND.

With Twelve Curious MAPS.

By E. BARLOW, Gent.

24

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MVSEVM
BRITAN
NICVM

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PREFACE.

THE *Laws* of Motion, eſtabliſh'd by Divine Wiſdom in the Nature of Things, are, without doubt, uniformly and univerſally obſerv'd throughout every part of the Creation; and conſequently, theſe *four* great Wheels of *Fluid* Nature, which I have undertaken to conſider, viz. *Springs*, *Rain*, *Wind*, and *Tide*; muſt have their conſtant Revolutions determin'd by the ſame Laws, and be adjuſted and carried on, exactly according to *Statical* Principles.

But it is equally certain, that *No Man can find out the Work that God maketh, from the beginning to the end* †; nor trace the Order of remote Cauſes, which lie involv'd in endleſs Combinations, to their firſt Origin, in the immenſe Regions of *Air* and *Water*: wherefore, being to treat of theſe *Effects*, which are ſo well known to us, and lie daily expos'd to our Senſes; I ſhall not need to amuſe my Reader with *Hypothetical* Conjectures: grounding my Diſcourſe all the way upon the *Things* themſelves, or ſuch acknowledg'd *Properties* of 'em, as are ſufficiently aſcertain'd by repeated Experiment and Obſervation.

As *firſt*, It being allow'd, that the Air gravitates (as appears by the *Baroſcope*) as well as Water; and Experience aſſuring us, that *Springs*, *Rain*, *Wind*, and the *Sea*, tend always directly *downwards*, unleſs ſome exteriour Impediment give 'em a Deflection: Hence I may conclude, that their common Tendence that way, by their own *Gravity*, muſt be the principal *interiour* Cauſe of their Generation, or Production; and that the Three former may be traced up to their firſt Origin,

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† Eccleſ. 3. 11.

gin, by following the Tract of their conſtant Motion (*downwards*) revers'd; with the ſame Certainty, that *Rivers* are traced upwards to their reſpective *Fountains*, which firſt produc'd 'em: And whereas the *Tide* conſiſts of an Inequality of the Sea's Surface; however it be *rais'd* above its natural Level, it muſt be *depreſs'd* again as much, by the Ponderation of its *own Weight*, to compleat its Tidal Motion.

But, becauſe all direct Motion muſt terminate at laſt; and the Circulation of theſe *voluble Fluids* is perpetual; ſome exteriour Agent muſt revolve 'em again *upwards*, contrary to their natural Propenſion: And ſince we find by Experience, that Light and Heat raiſe Water, in *Miſts*, up to the Clouds; and by rarifying our groſſer Air, ſwell it higher into the Sky: Hence it may reaſonably be concluded, that the Rays of the Sun, by hoiſing 'em Both aloft, and letting 'em fall down again; produce *Springs*, *Rain*, and *Wind*, alternately.

Theſe *Three*, whoſe Appearances are much fewer and leſs perplex'd, I have examin'd, after a brief manner, in my *firſt* Treatiſe: as a preliminary to my *ſecond* of the *Tide*; They all, after ſome ſort, affecting the *Sea*; But eſpecially the *Winds*, which immediately ſtir up its Surges: and more particularly thoſe Winds which *Trade* upon the Ocean; ſome *periodically*, to oppoſite Points at ſeveral Seaſons; whilſt others drive its Surface *continually* Weſtward: Whoſe Origin and Courſe I have deſcrib'd, in the Cloſe of my firſt Treatiſe; according to the *Hiſtorical Obſervations* of that moſt learned and accurate Meteorologiſt, Dr. *Edmund Halley*, the *Savilian* Profeſſor at *Oxford*.

Next, concerning the Exteriour Agent, which ſtirreth up the Sea, and cauſeth the *Tide*: In regard the Diurnal Courſe of the *Moon* comes up ſo cloſe, at every *ſix Lunar* Hour's diſtance, with the Terms of its *Floods* and *Ebbs*, as to argue as abſolute a Dependence thereon, as any Effect whatſoever can have on its proper Cauſe; and this ſo remarkably, That *ſuch a Moon makes ſuch a Tide,* is the *Navigator*'s common Expreſſion; It is ſcarce to be doubted, but that Her Influence is chiefly concern'd in the Tidal Affair.

But whether Her proper Action be to *raiſe* the Sea's Surface *above,* or *depreſs* it *below* its natural Level, ſeems not ſo eaſy to determine; ſince its Motion, alternately *up* and *down,* may be alike occaſion'd by Either.

The *Antients* generally attributed to the Moon a Power of *raiſing* or *ſwelling* the Surface of the Ocean, after the manner of Boiling Water: whence it was called the *Æſtus,* or Ebullition of the Sea; which they held was at *once* excited in the Parts directly under her *Meridian,* and thoſe, *diametrically* oppoſite to 'em: The former by her *direct,* this by her *reflex'd* Rays. In this Opinion we find *Ariſtotle,* with all the *Peripatetic School*; *Strabo*, *Pomponius Mela*, *Pliny,* &c. This laſt Author pleaſantly calls the Moon, (*) *Sydus* avidum, *trahenſque ſecum* hauſtu *Maria,* &c. And *Ariſtotle*'s Word, to expreſs theſe Ebullitions, is ἀμπώτεις; which he ſeems to explicate by κυμάτων ἄρσεις; ſaying, they do (†) Συμπεριοδεύειν ἀεὶ τῇ Σελήνῃ.

When the *Copernican* Syſteme was reviv'd, many of its Favourers endeavour'd to account for the Courſe of the Tide from the Motion of the Earth; as, *Galilæus,* Lord *Verulam,* Mr. *Hobbes,* and others: But not ſucceeding herein; *Des Chartes* brought in the *Moon's Preſſure* to its Aſſiſtance: (||) making the *Earth's Rotation* to ſtir up the ambient Air into Motion, and the Moon's Interpoſition, between the Inſide of her Orb and the Outſide of our Ocean, to compreſs it into a *Wind* within our Hemiſphere; which *Wind,* as he (miſtakingly) ſuppoſes, proceeding from the Rotation of the Earth to the *Eaſtward* (the above-named Dr. *Halley* having demonſtrated the contrary;) muſt carry with

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(*) *Hiſt. Nat. l. 2. c. 97.* (†) *Ariſt. de Mundo, c. 4.* (||) *Princ. Phil. P. 4. § 49.*

it that Portion of Air, which is incumbent on the *Eaſtermoſt* part of the Earth, forward to the moſt *Weſterly* Points thereof (far *ſwifter* than a *Bullet* out of the Mouth of a *Cannon*) in *twelve hours* ſpace: and the Tumour of Water, which it affects, muſt likewiſe accompany it through the *ſame* Space in the *ſame* Time. Which is inconſiſtent with all Obſervation; and muſt render the *Art* of *Navigation* altogether impracticable.

The Truth is, not only *Des Chartes*, but moſt other Authors who have handled this Subject of the *Tide*, have fall'n under the ſame grand Miſtakes: which are,

1. That they imagine its *proper* and *primogenial* Tendence to be from *Eaſt* to *Weſt*.

2. That it makes High-water in *all* Places, *where* and *when* the Moon is on the Meridian.

The quite *contrary* to both which, is found true by the beſt *Obſervation*; as I have taken occaſion more amply to ſhew throughout my *Second Treatiſe*.

Wherein the *Reader* (I hope to his Satisfaction) will find how I have endeavour'd to lay ſuch *Cauſes* of the Tide, as are no ways inconſiſtent with the *Effects* themſelves, or thoſe *Phænomena*, of which Experience and Obſervation has aſſur'd us: How, after I have trac'd its Courſe throughout the *Ocean* in general, I confine my Enquiries to the *Atlantic* Stem; and ſoon after within the Compaſs of the *European* Seas; whence I withdraw 'em to the *Britiſh* Coaſts; and after all (for clearer Inſpection's ſake) deſcribe the Tides within our *Engliſh* Channels: and have had Recourſe, all the while, to *Authors* of the beſt Repute, and our approved *Tide-Tables*, for Matter of Fact.

This *Eſſay* I have the more willingly ſubmitted to Publick View; that *Time* and *Opportunity* might, at leiſure, adjuſt *miſtaken* Circumſtances; and that, by the Aſſiſtance of freſh *Obſervation*, and Induſtry of *Art*, the whole *Theory* might, at length, be improv'd into a common Stock of Uſeful Knowledge.

CONTENTS.

Firſt TREATISE,

OF

Springs, *Rain*, and *Wind*.

CHAPTER I.

Of the Origin and Courſe of *Springs*.

Sect. 1. OF *the common Source of Springs in general; and how they are diverſify'd, by their different Deſcents thro' the Veins of the Earth.* Page 1

Sect. 2. *Of the Origin and Growth of* Day-*Springs*. p. 3

Sect. 3. *Concerning the firſt Source, and Production of* Top-*Springs*. p. 9

Sect. 4. *Whence* Bottom-*Springs proceed; and, how they are propagated in the Veins of the Earth.* p. 13

Sect. 5. *Concerning Springs of the* Deep; *whence they proceed, and how they are diſtinguiſh'd from the reſt.* p. 17

Sect. 6. *Objections againſt the precedent Account of the Origin of Springs, ſolv'd.* p. 20

Sect. 7. *The contrary Opinions confuted.* p. 25

CHAP. II.

Concerning the *Generation* of *Rain*.

Sect. 1. *Of the Common Source, and Production of Rain in general.* p. 39

Sect.

Sect. 2. *How Vapours, raiſ'd by the Sun to ſeveral Heights in the Air, grow, by their Deſcents, condenſed into Rain, and Hail, of as divers ſorts.* p. 43
Sect. 3. *How fair and foul Weather interchangeably ſucceed each other; and as diverſly affect the Sky at different Seaſons of the Year.* p. 49
Sect. 4. *How the Weather becomes ſettled in Winter; and changeth differently from what it did in Summer.* p. 55

CHAP. III.

Of the Production of *Wind.*

Sect. 1. *The general Notion of its Production.* p. 58
Sect. 2. *How Wind is produced of Air, by the Motion and Mixture of the Rays of the Sun; and, how it is directed by the* Situation *of the Earth, on which it falls.* p. 62
Sect. 3. *How the Motion of the Wind depends on the unequal* Poiſe *of the Air; and, how its Flux is diverſify'd in its Paſſage thro' it.* p. 66
Sect. 4. *Of the Production of* Storms *and* Tempeſts. p. 74
Sect. 5. *Of the Production of* Whirlwinds, Spouts, *and* Hurricans. p. 81
Concluſion. p. 88
Sect. 6. *Rain and Wind accorded by the Weather-glaſs.* p. 91

CHAP. IV.

Of the Motion of the Wind, as depending on the Courſe of the *Sun.* p. 97

Sect. 1. *Of the Motion of the* Trade-Wind, *and its Dependence on the Courſe of the Sun.* p. 100

Sect. 2. *Of the* ſhifting *Trade-Winds, and their Dependence on the Sun's Zodiacal Declination, with regard to the Equinoctial Poſition of the* Arabian *Sea.* p. 104
Sect. 3. *How the S. and N. Weſtern Monſoons are reſpectively regulated by the Situation and Figure of the* Arabian *Sea.* p. 107
Sect. 4. *How the ſhifting Trade-Winds are propagated in the Gulf of* Bengal, *and Sea of* China. p. 113
Sect. 5. *Concerning thoſe Winds which are adverſe to the general Eaſterly Winds, and are* perpetual. p. 116
Concluſion. p. 120

The Second TREATISE, of the TIDE;

OR,

The Ebbing and Flowing of the SEA.

PREFACE. Page 1

CHAPTER I.

Of the Ocean's continual Flux into the Weſt; and, of the Cauſe of the Tide; and, how it is effected, according to its full Extent. Page 5
Section 1. *Of the continual Flux of the Ocean, from Eaſt to Weſt, cauſed by the Wind; and, that its different Motion from the Tide, neither occurs*

occurs with it nor obſtructs it, as to the Subſtance of its Motion. p. 6

Sect. 2. *That the Tide is cauſed by the Moon's Preſſure upon our Atmoſphere; and, how it is effected.* p. 13

Sect. 3. *The Efficacy of the Moon's Preſſure upon the Sea, for the Tide's Production; and its ſeveral Qualifications for that purpoſe.* p. 19

Objection, from the Weather-glaſs, ſolv'd. p. 24

Sect. 4. *The Diurnal Courſe of the Moon, and the Motion of the Tide, adjuſted; and, the Regularity of her Preſſure's Application demonſtrated; and, how ſhe maketh a primary and a ſecondary Tide, with one Revolution.* p. 29

Sect. 5. *How the Tide's menſtrual Encreaſe is cauſed by the Concurrence of the Sun's Influence with the Moon, at her Change and Full; and its Decreaſe for want of it, at her Quadratures.* p. 33

Sect. 6. *How the Sun's and Moon's annual Courſes, thro' the Zodiack, jointly diverſify the depending Tides; and raiſe the Equinoctial Tides higher than the reſt.* p. 39

CHAP. II.

Of the Tides of the Ocean, as being bounded by Coaſts and Shores. p. 43

Sect. 1. *High-water ſtated as the Interſection of the Equator by the firſt Meridian; as being the Place leaſt obnoxious to any Confinement by neighbouring Coaſts,* &c. p. 44

Sect. 2. *Reflections upon the precedent Account of the Tides, near the Equator, in the Channel between* Guiana *and* Guinea. p. 47

Sect. 3. *How the Tide is ſtirr'd up by Preſſure, and continued by Libration; and, whither it extends itſelf before it makes its Returns.* p. 52

Sect.

Sect. 4. *The collateral Reſult of the Tide's Undulations, from between the Tropicks towards the Poles, in ſix Hours; and their Revolution back again, in other ſix; is ſhewn conformable to Reaſon, and teſtified by Experience.* p. 56

Sect. 5. *Of the circular Diffuſion of the Tide, from the Centre of its Tumour, in our North Atlantick Ocean, to its Eaſtern and Weſtern Shores; as alſo towards the* Tropick *of* Cancer, *and the* Artick Circle. p. 61

Sect. 6. *How the Tide is ſpread over the Atlantick Ocean, and communicates itſelf to other Seas,* &c. *and by its alternate Floods and Ebbs, makes ſtill a Reſtitution, correſpondent to the Diverſity of its Motion.* p. 66

Sect. 7. *How it comes to paſs, that the Coaſting Currents of the Ocean, which riſe beyond the Tropicks, conſtantly tend towards the Equator.* p. 71

Sect. 8. *Of the* Concourſe *and* Reſult *of the Ethiopick and Atlantick Tides, near the Equator; and the Irregularities which attend 'em in the Streight between* Braſil *and* Guinea, *explain'd and reconcil'd.* p. 78

Sect. 9. *How the Calm is occaſioned in the ſaid Streight; and differs from thoſe which happen in other Seas.* p. 83

CHAP. III.

How the Tide is propagated, and ſpread over our Weſtern Ocean; with ſpecial Regard to Time and Place. p. 88

Sect. 1. *Of the Application of the Tide to the* Globe *in general; with Regard to the principal Lines of the* Sphere. p. 89

Sect. 2. *Of the Tide's Application to our Weſtern Ocean; with a ſpecial Regard to the* Ethiopick *Diviſion.* p. 92
Sect. 3. *Why the* Atlantick *Flood is not devolv'd diurnally to the Weſtward, like the* Ethiopick; *but makes full Sea, from Eaſt to Weſt, at the ſame Inſtant.* p. 98
Sect. 4. *Concerning the* Circular Transfuſion *of the Secondary Tide; and, how it correſponds with the* Libration *of the primary one.* p. 102
Sect. 5. *Of the mutual Occurrence of the primary and ſecondary Tides, at the Places aforeſaid.* p. 105
Sect. 6. *The ſeeming Irregularities of the Atlantick Floods, examin'd and clear'd.* p. 111
Concluſion. p. 116

CHAP. IV.

Of the Tide's Reception into our *Iriſh* and *Britiſh* Seas. p. 117

Sect. 1. *The Tide's Diviſion, by ſundry Channels; its progreſſive Motion, thro' as different Roads; with regard to the* Time *and* Place *of High-water.* p. 118
Sect. 2. *Obſervations and Reflections upon the Diviſion and Progreſſion of the Tide, deſcribed in the precedent Section, with regard to the Shores.* p. 122
Sect. 3. *How the Flux of one Tide produceth another by its Reflux; and that one Flood may become many, by a diverſe Application to the ſame Shore.* p. 127
Sect. 4. *A brief Rehearſal of the moſt remarkable Occurrences of our* Britiſh *Tides already diſcourſed of.* p. 131
Sect. 5. *Of the Tide's Diverſity in* Height; *and, how it is gradually encreaſed, both in the Atlan-*

tick

tick Ocean which propagates it, and in our narrow Seas which receive it. p. 135

CHAP. V.

Of the great Diverſity of Tides in our Inland-Seas, or Lakes; and, how they are occaſioned. p. 141

Sect. 1. *Concerning ſuch Seas or Lakes as are wholly ſeparated from the Ocean, yet ſometimes Ebb and Flow by the Moon's immediate Preſſure.* p. 142

Sect. 2. *Of Inland-Seas which partake of the Influx of the Ocean by one ſingle Streight, or Paſſage; and, how variouſly they are affected thereby, in reference to the Tide.* p. 144

Sect. 3. *Of thoſe Gulfs or Lakes which, by receiving their Tides thro' ſeveral Channels, either add or ſubſtract from their accuſtomary Number in other Seas.* p. 149

Sect. 4. *Of the ſupernumerary Tides in the* Euripus; *and their Analogy with thoſe which ſometimes happen in our* Iriſh *Sea.* p. 153

Deſcription of the Euripus. p. 154

Sect. 5. *Obſervations upon the Diverſity of the Tides in the* Euripus; *and, how conſequent it is to my precedent Diſcourſe of the Tides in other Seas.* p. 161

Remarks upon the Obſervations aforeſaid. p. 164

Sect. 6. *Of the ſmall Number of Tides, in ſome other Places; and why, in the Port of* Tunkin, *there happens but one Flood in Twenty four hours; and twice each Month, no Tide at all.* p. 168

Sect. 7. *Of the various Floods and Currents found in the* Magelanick *Streight, of the* Boſphorus, *and at* Gibraltar; *their ſeveral Cauſes; and, the Manner how they are occaſion'd.* p. 173

Sect. 8. *A more particular Account of the Tide in the Streight of* Gibraltar, *from Experience and Reaſon.* p. 179

Sect. 9. *Of* Whirlpools, *ſtirr'd up in the Sea; their Dependence on the Tide; and, how they are occaſion'd.* p. 188

Sect. 10. *A more particular Account of the* Vortex, *or Whirlpool, on the Coaſt of* Norway; *and, how it is cauſed in every reſpect.* p. 192

Sect. 11. *Of Indraughts of Water, and ſubterraneous Rivers; and, their Accommodation to Land and Sea.* p. 197

Sect. 12. *A Recital and Explication of ſuch Inſtances of the various Motions of the Tide, which ſeem to be the moſt unaccountable.* p. 201

Sect. 13. *Concluſion: Wherein the modern Doctrine of* Attraction, *and its Fitneſs to explicate the* Phænomena *of the Tide, is conſidered.* p. 207

First

Firſt TREATISE.

CONCERNING

The Origin of Springs, Generation of Rain, and the Production of Wind.

CHAP. I.

Of the Origin, *and* Courſe *of* SPRINGS.

SECT. I.

Of the Common Source of Springs, *in general; and, How they are diverſify'd, by their different Deſcents thro' the Veins of the Earth.*

TO diſcloſe the Source, and Origin of *Springs* in general, by conſidering the Conſtitution of the *Matter* whereof they conſiſt, and obſerving the common Tract of their *Motion*; ſeeing they are all compos'd of Elementary Matter, (which is abundantly heavier than Air) they muſt ſtill tend downwards; and being alſo of a thin and fluid Conſtitution, muſt needs inſinuate themſelves with Eaſe, into the Veins and Cavities of the Earth, how crooked and perplex'd ſoever; ſo that to return upwards, or run Tranſverſly, muſt needs be contrary, or beſide their Natural Propenſion; and conſequently not to be admitted, but in Caſe of ſome Obſtacle or Impediment, which may Exterioully divert their Courſe, againſt their Interior Inclination.

And for Diſtinction's ſake: 1. They are divided into *Day-Springs*; which, either lying near the Surface of the Earth, or finding free Paſſages thither, break forth into the open Air, on their own Accord; while thoſe of the *Deep* are ſunk down ſo low, as to require Buckets and Chains to fetch 'em up again. Next, they are call'd *Top* or *Bottom-Springs*; inaſmuch as they appear either above the Rock, which ſevers the Soil from the Mine, or underneath it: Moreover, *Top*-Springs differ from *Day*-Springs, in that they ſtagnate between the Superficies of the Earth and the Surface of the Rock, till they be open'd by the Miner; and *Bottom*-Springs, that can be let off by Soughs and Trenches, are diſtinguiſh'd from thoſe of the *Deep*; which, to be drain'd by ſuch Means, is either altogether impracticable, or abſolutely impoſſible.

Next, it is farther obſervable, that all thoſe Sorts of Springs proceed originally from the ſame Source; to wit, *Rain* and *Dews*, diſtill'd from the Clouds: And they are diverſify'd by their Transfuſion thro' the Veins of the Earth, whereon they are ſcatter'd. For, in Caſe they be imbibed by a looſe and porous Soil, they preſently break forth again into *Day*-Springs; or, if their Courſe be obſtructed by ſome ſlimy or ſoapy Matter, they are ſtill exerted againſt the Miner's Pick, in *Top*-Springs; or elſe, if let down by the Chinks of the Rock, they meet him again below it, in *Bottom*-Springs; or finally, if they lie too far diſtant from any River, of a Lower Situation, to be Taken off practically; or elſe Lower than the Sea, to make that impoſſible; they are properly Springs of the *Deep*, and no farther to be Accounted for; the Floor they laſt fall upon, being Seamleſs, and ſcarce penetrable; and whether Solid, or Hollow, Uncertain: The reſt will be made manifeſt, by reſpective Obſervations, in the following Sections.

SECT. II.

Of the Origin, and Growth of Day-*Springs.*

IN the Search after the Original Source of thoſe Rills, and Currents of Water, which, iſſuing out of the Earth, are commonly call'd *Day*-Springs, or *Fountains*; the Firſt Conſideration that occurs, is, that their Natural Courſe, as conſiſting in Motion merely Local, & cauſed by the Propenſion of their own Weight, ſtill drawing them Downward towards the Center of the Earth, their Courſe muſt always be upon a conſtant Deſcent, from a Higher Situation to a Lower; and ſo muſt proceed Originally from *Rain*, diſtill'd from the Clouds: And if it happen, that at their Emergency out of the Earth, their Spring riſeth Upwards; 'tis cauſed by the Curvity of their Paſſage, that (*Syphon*-like) pointeth that Way; while the Preponderation of the Water, contain'd in its other Arm, deſcending from a greater Height, forceth it to Riſe, contrary to its Natural Inclination.

Hence it comes to paſs, that Springs ſeldom break forth in Plains, or Champion-Ground, for Want of an Aſcent to raiſe them, and a Deſcent to let 'em off again; but the Rain that chanceth to fall there, either ſtagnates into *Pools*, and *Lakes*; or if it be imbibed by the ſpungy Soil, it ſinks into Beds of Sand, or Gravel, to be convey'd by Subterraneous Paſſages, to ſome lower Situation of Valleys and *Rivers*, that diſcharge it laſt into the Ocean; or if it be employ'd to furniſh *Pits*, or *Ditches*, dug deeper into the Earth, they never riſe Higher than their firſt Source; or the Superficies of thoſe Plains, that imbib'd the Rain which firſt produc'd 'em.

But, in Caſe thoſe Springs get the Advantage of a Higher Ground, to Rill themſelves down into a Lower, by deſcending thro' the pervious Sand, or Gravel, till they break forth at laſt into the open Air; they run themſelves off in a joint Proportion, to the Extent of Ground whereon the Rain fell, and the Capacity of the Orifice that vents 'em; ſo that if the Former be but ſmall, and the Latter too large; ſuch weak and unconſtant Springs run themſelves out, almoſt as ſoon as the Showers are fall'n, that repleniſh'd 'em.

Or, if Springs of a ſtronger Stream, and a longer Continuance, chance to riſe upon Plains; the Eminence that feeds 'em, cannot be ſmall, nor afar off, and ſeldom above a League; and the Quarry of Stone, which conveys 'em thro' its Chinks, muſt crop out of the Ground in the ſame Place; or the Bed of Clay, or Marl, that had ſuppreſs'd 'em all along, muſt break off, or be diſcontinued, to let 'em off into the open Air; at a Rate proportionate to the Veins of the Earth, thro' which they are to paſs, and the Stock of Water that maintains them.

Afterwards, if we climb thoſe Mountainous Heights, which moſt abound with Springs, we ſhall find Cauſe enough for 'em; and a competent Extent of Surface, to receive a proportionable Quantity of Rain, for their Supply; and Clifts of Rocks every where wide open, to receive and convey it into the Caverns of the Earth, as Reſervatories to detain it; till the Chinks underneath, can let it off again at leiſure, for a conſtant Supply to water the Valleys below, perhaps for the whole Summer's Seaſon.

And, at laſt to mount the Tops of thoſe Hills, whence theſe Subterraneous Rivulets derive their Origin; they always occur to us upon a conſtant Deſcent, and are divided into Branches, Upwards; ſtill becoming gradually ſmaller, till their utmoſt Extremities terminate after all, at the Surface of that Height, from whence they drew their firſt Source; and were Originally diſtill'd, by innumerable Drops of Rain, from the Heavens themſelves; as being the firſt Source and Origin of all the *Day*-Springs, without Exception.

Hence it is remarkable, *Firſt*, That Springs are never found upon the Ridges of any Hills, for Want of Ground of a Higher Situation, to diſtill Currents of Water to ſupply 'em; nor upon thoſe Plains that are exactly Level, for Want of a Lower Deſcent, to carry off the Rain that falls upon 'em: *Next*, That the Springs, which break forth neareſt the Tops of thoſe Hills, are ſooneſt ſupply'd with Rain, and as quickly evacuated; but upon a Lower Deſcent, they become ſlower in receiving their Recruit, and longer in ſpending it; whereas Thoſe, that riſe at the Foot of the Hill, run perpetually; and ſuffer only a Decreaſe in Summer, of what they Increaſed in Winter, which may perhaps arrive at length, to an Equality: juſt as Water, poured (like Rain from the Sky with Intermiſſions) into a Tub bored full of Holes, and filled with Sand, is ſooneſt evacuated by Thoſe, that are neareſt the Top; which run off almoſt as ſoon, as the Infuſion ceaſeth; and the Lower they ſtand, the ſlower they are repleniſh'd, and hold out longeſt; whereas Thoſe of the lower Tier, flow perpetually; and perhaps at laſt, without any Variation at all.

For, ſo it happens in the ſtrongeſt Springs; which force their Riſe, out of the Bottoms of the Higheſt Hills; eſpecially when the Orifice of their Eruption, holds not a full Proportion, to the Source which maintains 'em; as doubtleſs it does not at *Holy-Well*, in *Flintſhire*, one of the moſt plentiful Springs in the

World; which being ſurrounded, almoſt on all Sides, with very High Hills, one heap'd upon the Back of another, keeps up its Stream to the Higheſt Pitch, in the greateſt Drought in Summer: Whereas another Spring at *Bardſea*, below the *Lancaſhire* Fells, in Winter, drives almoſt an equal Stream with it; yet decays conſiderably at the contrary Seaſon, for Want of a competent Supply, to keep it up to an Equality. A convincing Argument, that the Sea, tho' adjacent to 'em Both, is neither the Common Source of theſe Two Fountains, nor holds a ſtrict Communication with 'em; to keep the Former, exactly to its greateſt Height; and yet let the Latter fall with ſo conſiderable an Abatement, that near a third Part of its Stream is loſt.

And, to compare thoſe Springs with thoſe Rivers, that take their firſt Riſe from the Tops of the ſame Mountains; as they are fed by the ſame Showers of Rain, ſo their Growth and Increaſe continue much alike; but the Manner of their Courſe, and its Effects, become as different: For whereas Rivers receive their Recruits in open Chanels, expos'd to the Air; Springs, on the contrary, have Theirs firſt imbibed by the Earth, to be convey'd away thro' cloſe Conduits, under Ground: Thoſe ſtill float upon the Surface of their Paths, and can only vary their Courſe, To and Fro; but Theſe, that ſink into the Deep, are diverted every way, into an endleſs Maze of Perplexity: Thoſe fall with Precipitation, down the Valleys into the Plains, which they overflow; while Theſe derive their Rills out of all Sorts of Metals, and Minerals, through which they are to paſs into their Reſervatories, for the Summer's Seaſon: Thoſe, flowing all the while with open Banks and a free Paſſage, diſcharge their Floods upon every Shower; while Theſe, be the Feeder never ſo great, their Paſſage is ſo perplex'd, and ſtreightned on all Sides, as to paſs 'em off ſo regularly, that ſometimes they admit of no ſenſible Variation.

Thus much may ſuffice, for a full Diſplay of the Cauſe of thoſe Currents, that are call'd *Day-Springs*, and break forth of the Earth into the open Air; which, being Liquid, and following the Courſe of Nature, muſt eaſily inſinuate themſelves into the Crevices, and Caverns of the Earth; and withal, being of a heavier Conſtitution than Air, muſt every where expel it; and ſo, according to Reaſon, muſt Originally proceed from Showers of Rain falling upon a Higher Ground, which imbibes 'em; and are actually found by Experience, upon a conſtant Deſcent till their Eruption. Let us ſee what is to be ſaid of the Springs of other Sorts, which lye conceal'd in the Bowels of the Earth, till the Miner takes the Pains to diſcover 'em.

SECT. III.

Concerning the firſt Source, and Production of Top-*Springs.*

THUS far Reaſon and Experience being agreed about the Origin and Growth of *Day*-Springs, which ariſe out of the Earth into the open Air, on their own Accord; and chiefly ſerve for the Earth's Refreſhment, amidſt the Summer's Heats; and the ſupplying of Rivers with Water, in Droughty Seaſons; we muſt deſcend to Thoſe, which are diſcover'd under Ground by the Miner's Induſtry; and belong after a ſpecial Manner, to his Inſpection.

Now as to thoſe Rills, which are commonly call'd *Top*-Springs, tho' they jointly partake of the ſame Origin with thoſe of the *Day*, and are immediately ſupply'd by Showers of Rain; yet they never overflow on their own Accord, either for Want of Fall into ſome Lower Situation; or elſe becauſe they are not furniſh'd with a competent Force of Water to make an Eruption: but ſtill remain ſhut up in Beds of Sand or Gravel, lying between the Soil which covers 'em, and the Rock which ſuſtains 'em; and at a competeut Diſtance from the Surface of the Earth, to ſend up plentifully Steams and Vapours, to cheriſh and refreſh the Roots and Stems of Vegetables of all Sorts.

Concerning the Production of Springs of this Sort, inaſmuch as they depend on the

Miner's Pick and Spade to diſcover, and ſet 'em on foot; about the Beginning of *September*, after a Summer's Drought, when he firſt breaks Ground, he finds the Soil dry for a Spading deep; and ſo it continues, till the firſt ſteeping Shower ſinks into it, perhaps an Inch, before the Next falls; which, finding the Earth ſomewhat dampiſh, pierceth it conſiderably deeper; and the Third, after it is much better diſpos'd to receive it, penetrates deeper ſtill; and ſo does the Fourth, Fifth, *&c.* progreſſively; making the Way eaſier, for thoſe which follow; that ſhowry Moiſture, the lower it ſinks, growing denſer; yet 'tis ſo imbibed and incorporated with the Soil, that they grow into ſo clammy a Sort of Mud, that neither the One can properly be called Earth, nor the Other, Water; as long as that Month laſteth.

In *October*, that Moiſture being condens'd, ſinks by Degrees thro' this clammy Matter, into the looſer Sand, or Gravel, whoſe Pores are opener to receive it, and ſtony Particles cannot be pierc'd; whence it becomes a ſeparate Subſtance; and is actually ſtrain'd out of the Mud, by Percolation, into Water of a Fluid Conſtitution; yet ſtill remains divided into ſo Minute Parts, by the Smallneſs of its Receptacles, that it continues fix'd (as the Liquor does in a Honey-comb,) till it be ſqueez'd out by the Miner's Stroaks, which ſet it at Liberty: And having once got Vent, ſuch crizzling Rills creep thither-wards from all Sides, eſpecially from the Riſing Ground; whence their Fall is greateſt, and their Stock is moſt increaſed; and ſuch Springs as theſe are dried up in a few Days; but being repleniſh'd by every Shower of Rain, ſerve to ſupply *Ponds* and *Lakes* of a greater Capacity.

But, ſinking deeper into Beds of Sand and Gravel intermix'd, and opening vacant Spaces of a larger Size, to hold more Water; the Top-Springs iſſue out of 'em in greater Plenty; and increaſe, upon their Confluence with one another, at every turn, into briſk Currents; till at laſt, inſinuating themſelves into the Chinks and Crevices of the Baſtard-Rock underneath, they find Caverns and Reſervatories for a longer Seaſon; but ſtill with Intermiſſions in Summer and Winter, if they continue fair for any conſiderable Space of Time, and ſometimes without 'em: They begin to riſe in *October*, and hold out till a long Froſt dries 'em up; and the firſt Thaw ſets 'em on running again, and they laſt (with ſome Intermiſſions) perhaps till *June*; and ſo continue the Year round, to ſupply *Pumps* and *Draw-Wells*, which are their Reſervatories; until Droughts extraordinary quite exhauſt 'em.

But if the Soil, impregnated with Rain-Water, lye upon Clay, or Marl, or any other impervious Matter; and again, theſe chance (as commonly happens) to reſt upon Beds of Sand, or Gravel, for any conſiderable Space of Ground; the Water, which deſcending from the Crop-ſide is lodg'd therein, ſtagnates, till the Miner's Spade, or Augur, raiſeth it; and then it becomes a Spring of a ſtronger Current, and of a longer Continuance, and is moſtly perpetual; and if the Pit, or Pipe, whereby it is raiſ'd, proves ſtanch, it aſcends by Counter-Libration, as high as it had deſcended before; and keeps to near the ſame Stream, both in Summer and Winter, tho' never to an Equality.

And in Caſe the ſaid Springs receive part of their Recruits from ſome adjacent *Lake*, or *River*; 'tis always, as a late *French* Author well obſerves, from a Higher Situation: ſo that ſtill they are duly repleniſh'd with Rain, either at the firſt or ſecond hand; foraſmuch as Lakes and Rivers continually evacuate themſelves, either by Flux of Stream, or Emiſſion of Vapours; and muſt be repleniſh'd, either immediately by Rain from Heaven, or by Springs out of the Earth; as is manifeſt: And the ſame Author farther remarks, that they re-aſcend to the Height of their Fountains; as he ſays they do in *Paris*, near the *Sein*; where they Riſe and Fall with that River; and as they do near *Warrington* in *Lancaſhire*, within a Mile or Two's Diſtance from the River *Marſey*, where a Bed of Marl lies upon Sand; and no doubt but the like is done in all other Places, on the ſame Occaſion.

Thus all *Top*-Springs conſiſt of a Stock of Rain-Water, laid up moſtly in Beds of Sand, or Gravel, between the *Day* and the *Deep*; a commodious Depoſitory to receive it readily, upon every Recruit from Heaven; and to part with it as freely, when the *Bottom*-Springs require it: but they are only Springs of the Miner's making; or otherwiſe, they hold faſt what they can get; having room ſufficient for a Reſervatory, of the Vernal and Autumnal Rains, to ſupply the future Expence of the Summer's and Winter's Seaſons. Let us try, and ſee how their Correlative *Bottom*-Springs can draw 'em off upon Occaſion.

SECT. IV.

Whence Bottom-*Springs proceed; and how they are propagated in the Veins of the Earth.*

TO deſcend from thoſe Rills, which ſtagnate in Sand or Gravel, between the Soil and the Rock, till the Miner's Pick or Spade breaks open their Incloſure, to the *Bottom*-Springs, which are immediately derived from them; it is to be Obſerv'd, That the ſaid Sand and Water lodg'd together, reſt upon a Plane compos'd of ſundry Sorts of Metals; as Baſt, Iron-ſtone, White-Earth, *&c.* cropping out to ſupport 'em; which moſtly are of ſo compact a Subſtance, or lye ſo cloſe Bedded together, as ſcarce to let down any Water betwixt 'em; yet Others, of a more porous Sort, are interpos'd at certain Diſtances; or elſe are ſo disjoin'd from their Fellows, as to tranſmit a Quantity ſufficient to furniſh Springs of ſundry Sizes; according to the different Conſtitutions of the ſaid Metals, or the Capacities of the Clifts, which contain 'em.

Again, the ſaid Metals being not of Lumpiſh and *Globular* Figures, to ſcatter their Water every way alike, as Light paſſeth thro' Diaphanous Bodies; nor of a *Cubical* cut, to diſtract its Streams ſeveral ways at once; nor do they lye heap'd confuſedly together,

gether, to leave their Common Cour undetermin'd; but are flatted into *Plain* with a ſloaping Declivity, to let their in cloſed Springs deſcend leiſurely, and carr 'em off to a new Ground: And ſometim the whole Mine lies ſo true, and the Series o its Beds are framed after ſo equal and regular Manner, that the Miner, being inform'd wha *Dip* it hath, and which way it lies, may eaſ ly compute at what Depth his Springing Vei will be open'd, at any Diſtance within hi Compaſs; perhaps to a Foot at a Furlong, o to a Yard at a Mile.

Hence it is, that at what Depth, or Diſtanc ſoever within his Compaſs, he opens hi Spring with Pick, or Augar; the Orific which he makes, preſently draws all thoſe tha lye above it, and are fed by the ſame Vein Thither; inſomuch that Fountains, which ar fed by it, are often drain'd at a Mile's Di ſtance; while Others are ſpared, which riſ but a few Yards off, becauſe they derive thei Streams from other Sources.

And when his Pit is to be ſunk in a Bog where *Top*-Springs moſt abound; to keep i dry, his firſt Endeavour is to ſtop (if poſſible the Mouth of the Vein, which affects hi Mine; or to take it off with an open Trench if it be practicable, above Ground; or elſe t divert its Stream by a cloſe one, underneath (his Pit being already ramm'd about with tem per'd Clay) before its Irruption; and by thi Means, the Pains and Expence of tugging hi Water out of the Deep with Horſes and En gines, is ſaved; while it runs it ſelf off to th Day, upon its own Level.

And as for the final Retreat of theſe *Bottom-Springs*, under the Bowels of the Earth; if it chance that thoſe of the Deepeſt Sort can find no Vent into a Lower Situation, or want a Paſſage to convey 'em thither, they preſently ſtagnate; and upon every freſh Supply of Rain from above, their Courſe recoils by *Libration* upward, towards their firſt Source: And in Caſe the Veins of Metal, which contains 'em, prove ſtanch and ſtrong enough to ſuſtain their Weight, they fill, by degrees, all the Cavities, whereby they deſcended, up to the Top with Dead Water; and the ſupervening Showers of Rain no longer penetrate their Orifices (being brim-full already), but diffuſe themſelves in the ſaid Sand, or Gravel, as before deſcribed.

But, in Regard the ſaid Cavities always lie in a ſloaping declining Poſture, between Two Beds of Stone, or ſome other Metal, the One under the Other; and the Higher often becomes the *Roof*, and the Lower the *Floor* of the Mine, which is ſought for: Hence, if the Miner chanceth to pare the Rock over-head too thin, or to ſink his *Sump-hole* deeper than ordinary; the aforeſaid Dead-Water breaks out of its Encloſure, and ruſheth in upon him with ſo great Violence, as to endanger his Eſcape; and drowns his Work in a Deluge, but ſeldom beyond Recovery; unleſs that Space of Ground, which feeds thoſe Veins, and fills their Cavities with their Diſtillations, proves too great for his Pumps and Buckets to maſter; for otherwiſe, their Stock of Water being once drawn out, his Work is laid dry, and he eaſily keeps it ſo; having only its

Feeder to draw off as it comes, which cannot hurt him.

For an Inſtance of the former Sort; at *Scarsbrick* in *Lancaſhire*, the Miner, in his Search after Coal, or ſome other Mineral, when he had bored Twelve or Fourteen Fathom deep, thro' a cloſe and compact Sort of Metal, and dry all the while; chancing to meet with a more Porous and Open Vein of Earth underneath, a violent Stream of Water follow'd his Augar to the Top of the Ground, and roſe up a Tube at leaſt Ten Foot higher, by the Force of its Aſcent, to ſhew the Eminence of its Origin; and has maintain'd that Stream, without any ſenſible Diminution, ever ſince; in Proportion to the great Compaſs of Land whereon the Rain fell, which ſupply'd it: Whereas another Spring of the Latter Sort was rais'd in *Ellel* near *Lancaſter*, on the like Occaſion; which burſt out at firſt with the like Force, but ſoon ran it ſelf into a feeble Rill, and at laſt ceas'd; plainly ſhewing, that it deriv'd its Source from Higher Ground, than where it iſſued out, as well as the former; but wanted an equal Extent of Land to feed it; or a Metal of as cloſe and ſtanch a Texture, to preſerve it.

Hence it is manifeſt, that tho' the Plan aforeſaid conſiſts of Metals, how compact and cloſe join'd together ſoever; yet lying in diſtinct Beds, each beſide its Fellow; and all in the ſame ſloaping Poſture, with their Upper Edges cropping out to Sand or Gravel, impregnated with Rain-Water; they muſt needs tranſmit a competent Portion of it into *Bottom*-Springs, which conſtantly deſcend from the Riſing Side of the Mine, as deriving their Source from the *Top*-Springs; and penetrate the Deep by thoſe Degrees, and after the ſame Manner, as I have already deſcribed; (according to the daily Experience and long Obſervation made by a Perſon of Ingenuity and Credit,) without the Additional Supply of *Air condens'd into Water*, or of *Water rarified into Vapours*, in the Caverns of the Earth; much leſs of Rills, convey'd through its Cavities out of the *Sea* into *Bottom*-Springs; that are found Higher mounted than it, ſometimes an Hundred Fathoms.

Sect. V.

Concerning Springs of the Deep; *Whence they proceed, and How they are diſtinguiſh'd from the Reſt.*

TO deſcend, at laſt, to the Springs of the *Deep*, and conſider 'em preciſely, as contradiſtinct from Thoſe of the *Day*; it ſufficeth that they never appear to the Light of the Sun, on their own Accord; but as ſuch, they are co-incident with *Top*-Springs, which lie conceal'd, till the Miner diſcloſeth 'em by Force: And, inaſmuch as They penetrate the Depth of all Mines and Quarries; *Bottom*-Springs dive as deep into the Bowels of the Earth as They; and ſo can differ from 'em only in *Name*, but not in *Nature*; yet Theſe may be taken apart, as they are abſolutely undrainable by Soughs or Trenches, to a Lower Situation; and, conſequently, muſt lie as low as the Surface of the Ocean it ſelf, to find no other Reception.

Now, whether their Affinity to the Sea may cauſe a Participation with it; or their Submiſſion to its Surface create a Dependence of ſuch Springs on its Influence upon 'em: It cannot be Deny'd that *Salt*-Water may ſink into the Chinks of Rocks, and inſinuate it ſelf into their Crevices, as well as *Freſh* Rivers; but never to Exceſs, as is found by Experience; when the Miner drives his Coal-Works, under *Tine* near *Newcaſtle*, for whole Miles together; and does the like under the Sea it ſelf, on the Skirts of *Wales*, without any Remarkable Inconvenience on that Account; but rather, on the contrary, finds the *Roof* of his Trenches ſtancher, and the Chinks of the Rock ſtopp'd cloſer with Mud and other ſlimy Matter, than where they lie open to Sand and Gravel, in other Places.

'Tis confeſs'd, that *Draw-Wells* in Sea-Port Towns, and *Ciſterns* dug below the Flood-Marks on the Sea-Shore, ſometimes contract a Brackiſhneſs, either from an Intermixture of Salt-Water, or from the *Rock* that conveys it: But if the Springs lie above thoſe Marks, or at more than half a League's Diſtance off, (as thoſe at the *Wiches* do,) they are impregnated by Salt-Rocks, that are ſteep'd in Rain from Heaven, which is converted into that Briny Liquor; or elſe they never riſe Higher than the Brink of the Sea; though they be never ſo near it, or ſpring from Caverns never ſo much below it; as appears by the aforeſaid

Spring at *Scarſbrick,* that drains its Stream from ſome Fathoms below the Sea; and That at *Bardſea,* which diſchargeth itſelf immediately into It, at the Rate of an Hundred Tuns an Hour; yet Neither of 'em, in the leaſt, contracts any *Seaiſh* Qualification; or reſents its *Ebbs* and *Floods* one Jot, tho' they Border upon it.

Whereas, on the contrary, Springs of all Sorts expreſs their ſtrict Dependence on the Supply of *Rain*; by never failing to Riſe or Fall, conſequently to every Wet or dry Seaſon of the Year; eſpecially of *Summer* and *Winter*: Thoſe that lie deeper, growing ſucceſſively ſlower in receiving their Recruits, and holding out longer in ſpending them: Some begin to Riſe in *September*; Others ſtir not until *October* be over; and attain not to their full Height till *February*: Or, if they begin their Increaſe later, they continue Riſing till *March* or *April*; and Thoſe of the laſt Sort ſometimes, reach not their utmoſt pitch (as *Holy-Well* in *Flintſhire*) till *Midſummer*; *Top*-Springs being ſometime *Temporary*, and ſuffering Intermiſſions; but *Bottom*-Springs *Perpetual*: And the Deepeſt the moſt conſtant and Equal.

Thus I have travers'd the whole Courſe of Springs, from the *Top* to the *Bottom*; and found their ſubterraneous Rills at all Heights, ſtill deſcending by an undiſcontinued Tract, well known and cloſely follow'd by every *Collier*; without making any falſe Step, according to his beſt Obſervation: Nor have I laid any other Principles to ground my Diſcourſe, than what he ſtill ſuppoſeth, throughout his Work, to be *Self-Evident* and Undeniable : *viz.* That *Water* (which is the Matter whereof all Springs conſiſt) is *Heavy* by Nature, to preſs their Tendence conſtantly Downwards ; and withal of a *Liquid* and *Fluid* Conſtitution, to inſinuate them into ſubterraneous Paſſages of of all Sorts and Sizes.

SECT. VI.

Objections *againſt the Precedent Account of the* Origin of Springs, *ſolv'd.*

SO manifeſtly (as I have ſhewn,) do all *Kinds* of Springs, found in the World, proceed from the Diffuſion of Rain upon the Surface of the Earth ; (as being diverſified into ſeveral Sorts, by as different a Reception into its Bowels, and as various an Effuſion out again into the Open Air ;) that every rude *Collier* plainly ſees, and fully underſtands How it is Effected : Yet Thoſe, who wou'd have their Thoughts appear better cultivated by Reflection and Study, ſeem to be of a contrary Perſuaſion : Some raiſing *Objections* againſt Senſe and Experience ; and others advancing different *Opinions*, with as little regard either to the One, or the Other.

Firſt, Whereas it is commonly Reported, that Rain never ſinks deeper than *Ten* Foot into the Earth ; and yet plentiful Springs ſometimes occur in the *Bottoms* of the deepeſt Mines; 'tis a vulgar Error, As to the Former part of this Aſſertion, and flatly contradicts the Miner's Experience; who daily Obſerves, that all the Springs of the *Deep* conſtantly deſcend from the *Riſing* Side of thoſe Mines, which they affect; and derive their Source from the *Day*, as being Originally fed by Showers from Heaven; which, falling upon a ſpongy Soil, preſently ſink into Beds of Sand or Gravel; and thence deſcend into the Clifts of the Quarries underneath; and are transfuſed into the Mines below, to a Depth indefinite.

Secondly, To affirm that the ſtrongeſt Springs riſe out of the *Tops* of the Higheſt Hills, is as bold and unprov'd a Paradox as the Former; or, that they riſe ſo near the *Tops* of thoſe Hills, as not to afford a competent Space of Ground to gather *Rain* enough for their Supply, muſt needs oppoſe the Nature of Water; which never riſeth Higher than it is forced; as well as it contradicts Reaſon, which tells us plainly, that Springs, which are the *Effect*, cannot exceed the Height of the Place where the Rain falls, that *cauſeth* 'em.

And, to pretend the Origin of *Nile* for an Inſtance of ſo ſtrong a Spring, and ſo High mounted, is as diſagreeable to the Account of our Modern *Geographers*; who derive it from the Lake *Zembre*, which exceeds three Hundred Leagues in Compaſs, and is the great Drain of the Upper *Ethiopia*: Or, in caſe any of thoſe Rivulets, which fall into that *Lake*, ſhou'd flow from any ſuch Spring; Why it ſhou'd rather be the Head of *Nile* than of *Zair*, the third River in *Africk*, which alſo proceeds from the ſame *Lake*, is hard to conjecture: Unleſs to advance This as one Paradox, amongſt the Reſt which have been feign'd of the Origin of that River; ſince no ſuch Springs are to be found in our Quarter of the World; where *Rivers*, *Lakes* and *Seas* moſt abound, to furniſh 'em: To produce, I ſay, and inſiſt upon ſuch *Miracles* in Nature, and *Myſteries* to Reaſon afar off, contrary to the Experience of all *Europe*, muſt needs leſſen the Credit of the Reporter.

Thirdly, It is Urg'd, that the *Tops* of thoſe Hills, where ſuch Springs are found, are often Ridg'd with Rocks, which hang over the Sea, and are *ſeparated* Each from other; beſides, they are ſaid to be *Bare* and *Impenetrable* by Rain. To which may be *Reply'd*, that if thoſe Rocks be ſo pervious, as to let out Springs to ſpend themſelves; they muſt needs be as penetrable by Rain, to ſupply 'em: *Again*, if they be Bare, their Clifts are more expos'd to the Rain, and ſtand wider Open to receive it: *Moreover*, their Conduits being made of Stone, they will ſerve to convey their Rills into the Sea, with leſs Loſs of Water: *Finally*, Thoſe Rocks being ſeparated from their Fellows, their Springs muſt alſo be divided into ſmaller Rills, in the ſame Proportion.

And, for an Inſtance of a Spring of this Nature, we have one nearer Home, in Low *Furneſs* in *Lancaſhire*, which diſchargeth above a Hundred Tuns of Water Hourly, out of a bare and barren Rock, cloſe to the Sea; yet wants not, on the other ſide, a ſufficient Supply of the Rain, that falls upon the adjoining

Lime-Stone Hills, for a large Compaſs thereabouts; whoſe Clifts gape wide Open into the Air, to receive and ſwallow All down, as ſoon as it falls; without putting off the leaſt Rill any other Way.

Fourthly, It is Aſſerted, that in ſeveral Places of *Africk* and *America* (where is ſeldom Rains,) are ſuch plentiful Springs, that they preſently ſwell into vaſt Rivers: Whereas there are but Three ſuch Rivers in all *Africk*; and Two only in that Part of *America* that wants Rain; and no Two of 'em but drains as great an Extent of Ground as the one half of *Europe*; ſo that they ſwell not preſently to ſo vaſt a Bulk as perhaps our *Danube* does, which receives into its Stream *Sixty* Navigable Rivers, yet is not half ſo far Extended: Beſides, there are vaſt Tracts of Land, in both thoſe Quarters of the World, that lie *waſte* and *deſolate* for want of Springs to refreſh 'em; which plainly ſhews there are no ſuch Store of 'em, as the *Objector* ſuppoſeth.

'Tis true, the *Nile*, *Zair*, and *Niger*, are Rivers of the firſt Magnitude, and drain the greateſt Part of *Africk*, and yet are ſeldom repleniſh'd by Rain; but the Two Former are once a Year ſo plentifully furniſh'd, that their Winter-Supply holds out in ſpending it ſelf, from Our *Midſummer* till the *May* following, that it be wholly let off from the *Zembre*: And the Laſt draws its Origin from the Mountainous Part of *Ethiopia*; where there are all ſorts of Weather to maintain it, as well as upon the *Andes* in *America*, for three Hundred Leagues together; or elſe all *Peru* wou'd fare the worſe for't: And as for thoſe Places where it ſeldom Rains, Springs muſt be as rare, or elſe the *Dews* as great to ſupply 'em; the Nights being conſtantly near *Twelve* Hours long, to let 'em fall, before they can riſe ſo High into the Air as to become Rain; yet they are no leſs in Quantity, tho' not of the ſame Species.

When it is farther *Surmis'd*, that ſo ſmall a Supply of Water as the Rain affords, wou'd ſcarce ſuffice to furniſh Springs, for ſo continual and laſting an Expence. 'Tis *Reply'd*, that upon a juſt Computation, the Rivers ſwoll'n by the ſaid Supply into Floods, ſometimes vent more Water in *Thirty Hours* Space, than all the Springs, within that Compaſs, ſpend in a whole *Year*.

Again, The Showers that fall within the Space of *one Year*, wou'd, by a juſt Computation, ſuffice to ſtagnate all that Compaſs of Ground, whereon they fall, *Nineteen* Inches deep; which ſufficeth to furniſh a Supply for all thoſe Rivers which riſe within that Compaſs, during that Space of Time; with an *Overplus*, much more than to keep on foot the ſaid ſubterraneous Evacuations; did not the *Vapours*, rais'd by the Sun, take off the Remainder.

Laſtly, As to the *Fountain*, that in the Beginning of the World water'd *Paradiſe*; and the River that went out of it, which was divided into *Four* great Rivers, before our Lord had Rain'd upon the Earth: It is *Reply'd*, and may well be ſuppoſed, that God created All things (as well as *Adam* himſelf) in that *perfect* State wherein they were to continue, according to the Ordinary Courſe of Nature;

and, by Conſequence the ſaid *Fountain*, and its Rivers, were fully repleniſh'd with Water, as ſoon as they were Created; and were ſo to continue, till they cou'd receive a ſeaſonable Supply of *Rain*; as well as Now they do, from one Shower of Rain till another fall; and ſo alſo till a Second, and a Third progreſſively; not to Multiply *Miracles*, without Neceſſity.

And, not to omit thoſe *Objected* imaginary *Subterraneous Rivers*, which might poſſibly grow from a Defluxion of ſubterraneous Rills; yet *Whither* they can continually run, and *How* they can ſend up Springs to the Tops of Mountains, are alike Unconceivable: And, if Divine Providence has contriv'd ſuch a Paſſage, to let off the Superfluity of the *Caſpian*-Sea into the *Euxine*; as well as the *Guadiana*, which paſſeth ſeveral Leagues under Ground, to prevent a conſiderable Part of *Spain* from ſtagnating: 'Tis plain, that they were not Ordain'd for the *raiſing Springs* to ſuch prodigious Heights, as are imagin'd; but for Other Uſes.

SECT. VII.

The contrary Opinions Confuted.

OR, in caſe any *Additional Supply* of Rain, beyond what is Uſual, were ſtill required to keep on foot the ordinary Courſe of Springs; Let us ſee by what Means that

Deficiency can be made up, by Thoſe who advance that Perſuaſion.

The *Firſt* which is Aſſign'd, and chiefly inſiſted on, is the *Ocean* it ſelf; but with very little Hopes of Satisfaction; ſince the Sea is *lower* than the Rivers that deſcend into It: And *again*, Theſe are *lower* than any Part of the Land which they drain, as being always upon a conſtant Deſcent: Whence it follows, that no Spring can arrive from the Sea to any Part of the Surface of the Earth, (whence they All ſpring,) without riſing Upwards; contrary to the Bent of its own Inclination.

And when, to weaken this Conſideration, 'tis *ſurmiſed*, that the Ocean's Surface is *Protub* *rant*, ſwelling Higher in the Middle, than the Tops of the higheſt Mountains: 'Tis *R* *ply'd*, that plain *Experience* finds the Surfac of Water always, and every where, *Leve* and it is as much againſt *Reaſon*, that a *Flui* and *Ponderous* Body ſhou'd ſtand in any othe Poſture.

Again, To Abett this Miſtake, they obſerv that Ships entring into the Port make mor *haſte*, than they do out again; and it is n Wonder: For, coming In, they are alway upon a full Speed; but going Out, they a tain to that Celerity by *infinite* Degrees, whic muſt take up Time, and Retard 'em till the be Acquired.

And whereas 'tis Urg'd, that *Hills* are di cover'd *afar off* at Sea, which appear'd no *nearer* hand: 'Tis *Reply'd*, that the hinde moſt Hills, which are *laſt* diſcover'd, are r ally the Higheſt; and ſo from a true Proſpe

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appear afar off in their proper Place, and Overtop the Reſt; tho' the Surface of the Sea be not at all Advanced.

To correct this Miſtake, They alledge, that Salt-Water ſo much *preponderates* the Freſh, that the Depth of the Ocean, on that Account, will *raiſe* Freſh-Water Springs above the *Pique* of *Teneriff*: But of what Metal thoſe Tubes muſt be made, that cou'd ſuffice to ſupport Columns of Water to ſo vaſt a Height; eſpecially at ſo many Leagues Diſtance from the Shore, where the Ocean is ſo deep; and withal prove ſo ſtanch, as to convey it as many Leagues at Land, and to the like Height, without ſpending their Streams in the interjacent Plains, and Valleys underneath; No Man can tell.

And, altho' Salt-Water be *heavier* than Freſh; yet in caſe thoſe ſubterraneous Paſſages be of too *large* an Aperture, to take off the Briny Conſtitution of the Water by *Percolation*, it will ſtill retain its former Weight; and ſo it can never ſurmount the Surface of the Sea, from whence it came: Again, if thoſe Paſſages prove ſo *ſtreight*, as to ſeparate the Salter Particles from the Freſh-Ones; the protruſive Force of the Sea's Preponderation being *Violent*, the farther it goes the more it muſt Abate, and ſo fall ſhort of its firſt Origin; while the Motion of the Water's Gravitation, ſo convey'd, being *Natural*, muſt ſtill recover its proper Tendence Downwards, till at laſt it become Perpendicular.

And it is vain to have recourſe to *Filtration*, to advance thoſe Springs above their Origin;

whether they be pretendedly deriv'd from the *Ocean*; or rais'd by ſubterraneous *Lakes* or *Rivers*, generated in the Bowels of the Earth: As if it were eaſier to *climb* a Hill, than to *walk* upon a Plain; or more feaſible to force Water *up* a *Filter* againſt its own Inclination; than to drive it *forward* upon a *Level*, without any ſuch Impediment.

For as to the *Filter*, thro' which the Stream is to paſs to the Height deſign'd; ſince it has no *Attractive* Vertue to raiſe it; and may be made of any Porous and Pervious Matter; and is not Actuated with any kind of Motion that is Local, to *force* it Upwards againſt its Inclination; whether it conſiſts of a Texture of *Filaments*, finely twiſted into a Thread of *Flannen*; or be compos'd of *Globular* Particles, maſs'd as cloſe together as common Earth is; It can only aſſiſt to *ſupport* that Stream, while ſome Exterior Agent takes the Pains to *raiſe* It.

And, foraſmuch as neither the Water can raiſe it ſelf, nor the Filter ſufficeth to perform that Office; the *Preſſure* of the *Atmoſphere* muſt enliven the Work, by its *Incumbency* upon the Fountain's Superficies, and drive the Stream up into the Cotton; and after That, ſuſtain the impending Column; and, by an ever-repeated Impulſe, ſtill keep it in Motion: But, in regard Water is a *Fluid*, as well as *Heavy* Element; to perfect the Operation, Ambient Air muſt encompreſs the Filter *alike on all Sides* at once, to keep the Current within the Compaſs of its Encloſure; till it arrive to the utmoſt Pitch, that the Energy of its firſt Impulſe cou'd raiſe it; without ſcattering one Drop of its Liquor, or ſuffering any perceptible Diſtillation.

Now, in Regard the *Label*, on the deſcending Part from the Center of its Gravity muſt be alike ſurrounded, and compreſs'd by the Air on all Sides, from Top to Bottom; the incloſed Stream muſt, every where, meet with the ſame Difficulty to make any Eruption: And whereas, at its Aſcent, the Threads of its Context ſerv'd for Steps to climb to its ſtated Height; Now, upon its Deſcent, they fit as well for Seats of Repoſe, to retard its Motion; ſo as to hold every proportionate Part of it *Equilibrious* with its Oppoſite; and keep the whole ſteady, in an equal Poiſe; till the Snout of the Filter reach below the Surface of the Fountain, to draw the Stagnation into a *Current* by its Preponderation.

Thus *Filtration* is found expedient for *purifying of Liquors*, by Percolation thro' ſome porous Matter, from Veſſels of a Higher Situation to a Lower: Nor does it import, whether the Capacity of the Filter be great, or ſmall; or the Ciſtern, wherein it is dipt, be of a larger, or more contracted Orifice; or that it be ſunk deeper therein, or not; nay, tho' it were to the Bottom of the Sea: for (*Syphon*-like,) to whatever Height it ſhou'd advance its Stream, it wou'd not part with one ſingle Drop, till it deſcended as low as the Fountain whence it aroſe: So vain it is to imagine, that *Lakes* and *Rivers*, embowell'd in the Earth, ſhou'd, by this Means, ſend forth Springs on the Tops of the Higheſt Mountains: When Reaſon and Experience makes it plain and manifeſt, that None can be vent-ed a Foot above its firſt Source ; let the Filter be of what Compoſition, Capacity, or Application ſoever.

After all, the ſaid Springs muſt be repleniſh'd by thoſe ſubterraneous Conduits, upon every Increaſe, at the Bottoms of the Hills, before their Supply can reach their Tops; and muſt rather obſerve the *Flooding* of the *Sea*, than the Falling of a *Shower* of Rain: Whereas, on the contrary, Thoſe that are Higheſt mounted are ſooneſt furniſh'd, and as quickly run off again, after the Shower is fall'n ; without any Regard to the Sea at all; which, belike, has not been rais'd a Foot above its Natural Height, by all the Rain that ever fell, before the Deluge or after it, ſince the Creation.

To Others who pretend to Argue, from the *Effect* to the *Cauſe*, That *Intermitting* Springs, which ſo much reſemble the Ebbing and Flowing of the *Tide*, muſt needs depend on the *Ocean* for it ; 'Tis ſoon *Reply'd*, That their *various* and uncertain Motions Conclude the Contrary ; ſome Ebbing and Flowing every *five or ſix Minutes*, as One near *Settle* in *Yorkſhire*: Another every *ſix Hours*, as in the Dioceſs of *Paderburn* in *Weſtphalia* : A Third at *Peak*, about once *a Week* ; the *Gypſes* at *Beverley*, ſcarce once *a Year* ; and the Eruption of *Pendle Hill*, happens but once in an *Age*. An Irregularity, not deducible from any that is found in the *Ocean* it ſelf.

Yet all their Variety of Motions, whether of *Top* or *Bottom*-Springs, is commodiouſly ſupply'd, and kept on foot, by *Rain*; according to their different Exigencies; by the Help of *Reſervatories*, to receive and retain it from Flood to Flood; fitted with *Valves*, placed in the Veins of the *Earth*, as in the Bodies of *Animals*; to Open by their *Repletion*, and ſhut again, by their own Weight, after every *Evacuation*. A *Theory* that is made out by their reſpective Appearances of both Sorts, to be Matter of Fact.

For an Inſtance of a *Top*-Spring, that varies both its *Flood* and the *Time* thereof, with the Weather; That, near *Settle*, fills with every Flood a Well *four Foot* long, *three* Broad, and *two* Deep, in *five* or *ſix Minutes*; which ſinks again (its Sides and Bottom being leaky) to *four Inches* Water, in the like Space of Time; as long as the *Wet* Seaſon continues: Which no ſooner grows *Droughty*, but the ſaid Floods become gradually *leſſened* and *retarded*; till at laſt the Extenuated Current, finding an eaſy Paſſage between the *Valve* and the *Orifice* (which it ſhuts not cloſe) ſlides along its Channel at its own Rate, Evenly, without any great *Increaſe*, or *Diminution*, ſometimes for a whole *Month* together: While on the Contrary,

Bottom-Springs, which are conſtant and equal in themſelves, keep their Floods to the *ſame* Height, and Intermiſſions to an *equal* Time: And That, in the Dioceſs of *Paderburn*, Remarkably, complies exactly with the Ebbing and Flowing of the *Sea*, in both the ſaid Reſpects; loſing it ſelf twice in *four and twenty* Hours, and returning back at the Interval of *ſix* Hours; and with ſuch Violence, as to drive *three Mills* : Yet, notwithſtanding, i not in the leaſt Influenced thereto by th Surges of the *German Ocean* ; at *forty Leagu* Diſtance from It, and more than ſo many *Fathoms* beneath it : But muſt be ſupply'd entirely by the Clouds from Heaven, and ſuffer its Intermiſſions from the Means aboveſaid Its *Reſervatory* collecting Water, in order to ſupply its Flood, with a *Valve* ponderous enough to with-hold it to its full Height ; and ſo cloſe, as to loſe its Stream twice in *four an* *twenty Hours* ; till the Rainy Currents force it to return back again, after the Interval of *ſi* *Hours* : With the ſame Conſtancy and Exactneſs, that the Sea Ebbs and Flows twice in the ſaid Space of Time : And by the Appointment of the ſame *Powerful* and *Provident* Hand, which Created all things in *Number*, *Weight*, and *Meaſure*.

And, as for thoſe Springs which, in ſome Meaſure, ſeem to obſerve the Motion of the *Tide* ; becauſe they are near the *Sea* it ſelf, they muſt either lie below the *Flood-Marks*, to be Influenced by it ; Or elſe are fed by thoſe Rivers that raiſe their Floods to ſo great a Height, as to reach their *Level* : Or, if this general Rule admits of any Exception ; it muſt happen, when the ſwelling of the Sea, or River, *obſtructs* the Paſſage of thoſe Springs ; Or, at leaſt *retards* the uſual Swiftneſs of their Deſcent; ſo as to make their depending Fountains to Overflow, or ſwell Higher than Ordinary.

Nor can it be any longer Objected, that thoſe *Salt*-Springs, which are found afar off at Land, are either produced by the Sea, or communicate with It ; ſince the late Diſcovery of the *Salt-Rocks* at the *Wiches* in *Cheſhire*, where thoſe Springs moſt abound and are impregnated by them: Nay rather, the *Sea* it ſelf is beholden to ſuch *Rocks* for its Briny Conſtitution; and doth not conſiſt of One ſimple Element, but is a Compound of Two different Subſtances, to wit, of *Salt* and *Water*; which are eaſily ſeparated, Each from the Other, by a *Filter* or *Alembick*; and as well by *Percolation*, as *Diſtillation*.

Others as vainly imagine, that an Exceſs of *Heat*, contracted in the Bowels of the Earth, evaporates Water (like Smoak) thro' the Clifts of thoſe Mountainous Heights into the Open Air; and inſiſt upon the Heat which affects our *Baths*, to confirm their Opinion: But in this Suppoſition, the Springs which are to be rais'd ſhou'd iſſue out of thoſe Clifts, on the *Riſing* Side; whereas daily Experience finds them ſtill deſcending towards the *Lower*; as deriving their Extraction from a more ſublime Origin, Heaven it ſelf.

Nor does the Warmer Temper of thoſe Salubrious Fountains, evince their Heat to be contracted from Elementary Fire; as being of too Active and Diffuſive a Nature to permit any *Cold Springs* to riſe ſo near 'em, as commonly to fall within the ſmall Compaſs of the ſame Fountain; but rather derive their Warmth from the *Sulphurous* Veins, thro' which they paſs; Or elſe, They are all impregnated, in their Paſſage, with ſeveral Minerals of diſagreeing Spirits, which cauſe their Heat by *Fermentation*; like *Antimony* mix'd with *Sub-*

limate; or Raments of *Iron* with Flours of *Sulphur*.

But, to allay the imaginary *Heat* of the laſt Opinion, it is thought by Others, that the exceſſive *Cold*, engender'd within the Earth, condenſeth the *Air*, which is ſhut up in Cavities, into *Water*: And hence, They ſay, it is, that a Stone, or Plate of Metal, caſt upon the Ground, where it is expos'd to the ſcorching Rays of the Sun, contracts a Moiſture, by the Refrigeration of the Air, underneath; whereas they rather ſerve for a Cover to ſuppreſs the Steam, that wou'd otherwiſe breath out of the Earth where they lie, and vaniſh into Air; but for want of a free Paſſage upwards Thither, it is condenſed into Water, by that Stop put to its Motion.

Or, in caſe either Vapours breath'd up, by an Exceſs of Heat, out of the Bowels of the Earth; or Air, condenſed in thoſe Caverns by extream Cold, gave Springs their Origin; the exceſſive Cold and Heat of the Winter's and Summer's *Solſtices*, muſt needs reſpectively contribute to their Increaſe: But we find by Experience, that the Froſt of the One dries them up, as well as the droughty Heat of the Other; whereas the Rain of the Spring and Autumnal *Equinoxes*, where-ever it falls, Increaſeth them in the ſame Meaſure; and after it is fall'n, leaves them upon as conſtant a Decay, as being their proper Cauſe; which, when 'tis Apply'd they immediately *Flow*; and when 'tis Remov'd they *Dry up* again, and vaniſh to almoſt Nothing.

And the *Thermometer*, at once confutes both theſe Opinions ; by ſtating the ſuppoſed Exceſſes of the Heat and Cold of thoſe ſubterraneous Caverns, in a *Mean*, between the Extreams of *Winter* and *Summer* ; ſhewing manifeſtly, that the conceiv'd Difference proceeds purely from the different Diſpoſition of Senſe, as making an unequal Judgment at both Seaſons ; excepting only in ſuch Places, as are Actually ſet on Fire ; or where Mines of *Sulphur*, *Vitriol*, &c. abound : Yet their Heat no more cauſes the Springs that are found There ; than the Cold of *Lead*, *Al-* *me*, &c. influenceth Thoſe, that abound in other Places.

Laſtly, Others inſiſt upon many *Concurrent Cauſes*, for raiſing the ſame Springs ; or elſe, ſay They, if *Rarefaction*——, *Condenſation*——, or the *Sea*——, did not jointly concur with *Rain* ; thoſe Springs, that riſe upon higher Hills than Showers can ſurmount ; or deeper in the Earth than They can penetrate, wou'd be weakly furniſh'd ; but We have ſhewn reſpectively, in Both theſe Caſes, that ſuch a *Concurrence* wou'd be Impoſſible : Unleſs (as before admitted), they were ſurmounted by ſome Neighbouring Sea, or Conſtagnation of Water, that might ſupply 'em. Againſt which Reply

It is *Rejoin'd* ; that *Pendle*, *Penigent*, and *In-* *borrow* Hills, (which are remark'd, by *Cam-* *n*, for the Three higheſt in *England* :) abound with Springs, beyond any ſufficient Supply of *Rain* to recruit 'em : *Anſw.* Whereas the Laſt, which diſtinguiſheth it ſelf from its Neighbouring Hills of an inferior Rank, by having its tall Head moſtly cover'd with *Rain*, or *Snow*, according to the Seaſon of the Year, (while the Reſt ſtand Bare and Dry,) tho' its Top be Flat and Level for a *Quarter of a Mile's* Compaſs; yet it has not any Spring upon it, till after ſome Yards Deſcent; and There but One, which might paſs thro' a Quill: On *Penigent*-Hill appears no Spring at all, till after *Thirty* Yards Deſcent from the Top; which, tho' it be gather'd from a great Compaſs of Ground that lieth above its Orifice, yet its Stream little exceeds the Former: And as for the Eruptions of Water out of *Pendle Hill*, which *Camden* takes notice of; but One of them has happen'd within *Thirty* Year Space, and then but of an *Hour* or two' Continuance; and 'tis ſupply'd by a *Bogg* that covers the Top of the Hill; and onl breaks out after long Surfeits of *Rain*, whic cannot get ſufficient Vent any Other Way.

It is Urg'd after all, that the Fountai which begins the Eaſt and Weſt *Calders* ne *Townley*, riſeth ſo exactly on the Ridge o thoſe Hills which ſeparate *Yorkſhire* from *La caſhire*, that it runs Both Ways at once. *Anſ* And 'tis no Wonder; being a large *Bogg* which makes a Gap between Two *Mountain* of *Thirty* or *Forty Yards* above its Heigh which ſupply it with Water very commod ouſly; and 'tis ſo evenly ſeated, or rather R ſing, in the Middle, as to ſend down its Cu rents on Both Sides at Once.

Yet theſe *Inſtances*, and ſo repreſented, hav been receiv'd for Unqueſtionable Truths b the moſt Curious and Ingenious Obſervers

th

the *Wonders of Nature* in Thoſe Parts; and paſs'd thro' all Ages for Unanſwerable Objections againſt what has been here advanc'd concerning Springs; and perhaps might have continued to be reputed ſuch till the World's End; if farther Enquiry had not been made into the Truth thereof, upon a ſpecial Occaſion: Whence may be collected, what Credit ought to be given to Thoſe many Learned and Grave *Authors*, who relate the like *Prodigies* of other Places; and what is to be Reply'd, to their Accumulated Teſtimonies: Namely, that they took their Informations at firſt upon ſlight and ill-grounded Reports; which, being once accepted *without due Examination* by their Ring-Leaders, paſs'd for current Truths with all their Followers; Who either made it not their Buſineſs to inform Themſelves better; or were never in proper Circumſtances for that Purpoſe.

So plainly doth it appear from all that has been Alledg'd both *Pro* and *Con*, that *Rain* abundantly furniſheth all the *Fountains* in the World with Water; without being beholden o ſuch Imaginary Apprehenſions, as that *Air* condens'd into Water by the *Coldneſs* of the Earth; or *Vapours*, rais'd by its *Heat* out of its Bowels; much leſs Streams convey'd thro' its Cavities out of the *Ocean*, can in the leaſt Affect 'em; but rather, *Rain alone* performs the Work: Which never Falls, but gives 'em an *Increaſe* in the ſame Meaſure; nor is Withdrawn, but they ſuffer a proportionable *Diminution*: So vainly do we Grope at Noon-Day for *abſtruſe* and occult Cauſes; while the only True One is plain and *manifeſt* before our Eyes.

And as for *Top*-Springs, whic ever appear to the Day on their own accord; and *Bottom*-Springs, which lie abſolutely buried in the Deep; the Miner no ſooner diſcovers *Where* they lie, but he infallibly determines *Whence* they come; *viz.* the Former from Rain, diſtill'd thro' the Soil; and the Latter deriv'd from 'em, by ſuch Paſſages as the Quarries afford, to ſend 'em down into the Mines underneath: Nay, even Thoſe which are found deepeſt in Places adjacent to the *Sea*, ſo rarely partake of its Influence, that it were as much a Paradox to ſay, (in general Terms,) that they proceeded from It; as to Affirm, that Mankind were a *Blind Species* of Animality; becauſe ſome *One* Perſon might, perhaps, be found *Short-ſighted*, in every Pariſh:

Which is but a weak and far-fetch'd Exception; yet the only One, that either *Experience* can find out, or *Reaſon* admit to this general Rule: *viz.* That *Springs*, of all ſorts whatever, owe their *Subſtance* and Being to the *Showers* and *Dews* which fall from Heaven; their *Quantity*, both in Size and Duration, to the *Capacity* and *Depth* of thoſe ſubterraneous Cavities which they penetrate; and their ſpecifick *Qualities* to the ſeveral *Metals* and *Minerals*, which embue 'em in their Travels thro' the Bowels of the Earth: Let us proceed to the *Generation of Rain*, which is to ſupply 'em; and to be again ſupply'd by 'em Interchangeably, for Ever.

CHAP.

CHAP. II.
Concerning the Generation *of* RAIN.

SECT. I.
Of the Common Source and Production of Rain *in general.*

TO proceed from the Diſcovery of the *Origin* of *Springs*, to the *Generation* of *Rain*; ſince Both alike conſiſt of Water, as being Actually in Local Motion; the *Former*, ſtill perpendicularly deſcending towards the Center of the Earth; and the *Later*, rais'd up vertically into the Air by the Beams of the Sun; to be let fall down again by the Poiſe of its own Weight: This redoubled Motion, affecting not only that ſmall Portion of Water, which ſupplies *Fountains* and *Rivers*; but the whole Maſs of Rain, which plentifully repleniſheth both *Sea* and *Land*, throughout the Univerſe: My preſent Endeavour muſt be, to demonſtrate How, and by What farther Means, ſo vaſt a Body of That heavy Element can be continually kept in Motion; ſtill *Aſcending* and *Deſcending*, by an ever repeated Reciprocation.

To give the Firſt effectual Stroak for its Motion *Upwards*; the Sun, by the Intromiſſion of his Rays, diſſolves the Continuity of the Surface of that Water whence it was Extracted; and pares off what is more ſubtle into ſmall Particles of an Inviſible Size; that, by a Diviſion ſo Extraordinary, he may make a proportionable *Increaſe* of their *Superficies*; to hold 'em faſter, and tranſmit 'em with more Eaſe thro' the vaſt Tract of Air they are to Aſcend: As Bars of *Iron*, drawn into ſmall *Needles*, will ſwim upon Water as Chaff; and a *Milſtone*, pulveriz'd and ſcatter'd in the Air, may be toſs'd To and Fro, by every Blaſt of Wind, like a *Feather*: And the Reaſon is, becauſe Quantity *divided*, increaſeth its *Superficies* in the ſame Proportion; tho' the *Subſtance*, or Matter contain'd therein, remains ſtill the ſame, both in Bulk and Weight, that it was before the Diviſion was made; ſo muſt alſo the *Subdiviſions* proportionably increaſe in the One Reſpect (without meddling with the Other,) to an indefinite Progreſſion.

But to whatever Number thoſe Subdiviſions be multiplied; or be thoſe ſeparated Particles extenuated never ſo much; yet ſtill they remain *Heavier* than any equal Proportion of the Ambient Air; and, by Conſequence, will not ſwim, but ſink in it (as the Sediment ſinks to the Bottom of Liquors;) Unleſs the Rays, which made their firſt Separation, being reverberated back from the Surface of the Earth, raiſe 'em up by their Rebound; and continually ſupport 'em to the Height to which they were Advanced: So that upon any Abatement, either of the Force or Motion of thoſe Rays, the ſaid Particles muſt ſubſide, and ſink down again to the Place from whence they Aſcended; Thoſe that precede ſtill making the Way Eaſier, for their Followers to overtake 'em; and being Liquid, to *concorporate* with 'em into a *double* Proportion Progreſſively: The firſt Compoſition conſiſting of *Two* Particles, conjoin'd; the ſecond of *Four*, the third of *Eight*, the fourth of *Sixteen*, the fifth of *Thirty-two*, and ſo indefinitely; every Concretion haſt'ning their Fall, (in Proportion to their Weight,) into a greater Precipitation.

Thus *Rain* is Generated of *Vapours*, rais'd by the Sun; which become *ſpecified* into ſeveral Sorts, in their Fall, by *Five* ſucceſſive Concretions.

The 1*ſt* conſiſts of the Primogenial Atoms of Moiſture, of the *ſmalleſt* Size, and advanc'd to the *greateſt* Height; which, condens'd by the Cold of that Region, and being weaklieſt ſupported by the Sun's reflected Beams, at ſo great a Diſtance from the Earth, firſt begin to Fall, and give timelieſt notice to the *Baroſcope*, of the Change of Weather; but remain near Inviſible, like the Fall of *Dew* on a Summer's Evening.

The 2*d* Concretion conjoins Two, or more of thoſe Drops of the firſt Compoſition, into One; ſo as to overcaſt the Firmament with a *Foggy* Obſcurity; which is expreſs'd by the Sun, with a *Glaring Splendor* around his Diſk; and the Moon, by a *Ruff* about Her of a ſecondary Light; while the Stars can ſcarcely peep thro' it; and Thoſe, only Here and There one, of the *firſt* and *ſecond* Ma nitude.

The 3*d* condenſeth into a *Miſty* Obſcurit which deprives us of the Sight of thoſe Gre Luminaries, tho' there appear no Clouds, t Guſts of Wind drive 'em on Heaps; whic ſtill grow more *Opacous*, till

The 4*th*, rendring 'em no longer ſu portable by the Air, diſtills a *drizzling* ſort thick and *Showry* Rain, conſiſting of a Mul tude of ſmall Drops; which, at

The 5*th* and *laſt* Concretion, incorpora themſelves into *Rain*, in full Proportion: An this Account of the Generation of Rain, thr all its Deſcents, ſerves well enough for t *Summer's* Seaſon; while the Weather is war and the ſaid Vapours liquid.

But in *Winter*, when the Air is chill'd wit Cold, and thoſe Vapours are benumm'd wit Ice, the Scene is chang'd; For

Firſt, Thoſe *Dewy* Atoms which remain Inviſible, now beſpangle the Sky by the ſmalleſt Size, and moſt regular Refraction o the Sun's Rays, with the glittering Brightne of a *white Froſt*: *Next*, Each Two of th Points conjoyn'd, making a Line, become *Hoar-Froſt*, and create a *Fogg*-like Duskine by their Irregularity: *Thirdly*, Each Two o theſe Lines laid together making a Plan many of them interwoven into one Piece, b their fleeting Motion in the Air, (inſtead of *Miſt*) become Fleeces of *Snow*; and *Fourthl* Theſe growing more ponderous and tumblin down headlong from the Sky, rowl themſelve into *Balls*; which *Fifthly*, bringing Froſt alon with 'em into a moiſter Region, are cruſted over with Shells of Ice, into *Hail*-Stones, which makes the Operation compleat.

Now, in Regard the ſame Portion of Moiſture (which was *Rain* while it remain'd liquid) became *Hail* by Congelation ; and Both originally proceeded from Particles of the ſmalleſt Size and rais'd to the greateſt Height by the Sun ; and deriv'd their Pedegree from 'em, thro' an equal Number of Deſcents, by the Impulſe of their own Weight : It now occurs to ſhew, on the Converſe, How they are daily remounted, by repeated Efforts of his Rays, to the foreſaid Stations ; and as it were regenerated, Each apart, without any Deduction or Dependance on the Reſt ; according to their ſundry Sorts and Sizes, and with Reſpect to their ſeveral Uſes.

SECT. II.

How Vapours, rais'd by the Sun to ſeveral Heights in the Air, grow, by their Deſcent, condens'd into Rain, *and* Hail, *of as divers Sorts.*

NOW, ſuppoſe the Air to be purg'd of ſuperfluous Vapours, and the Sky render'd ſerene and clear, by their Evacuations.

The *Firſt* Effort of the Sun's Rays exhales, as it were by Reſpiration, the moſt ſubtle and minute Particles of Moiſture from all *humid*

Bodies, (as well as Lakes, Rivers, and Seas,
but eſpecially from Vegetables; which gentl
diffuſe their Balſamick Odours thro' the Ai
till the Evening Sun, withdrawing his Beam
lets 'em fall again, almoſt imperceptibly, in
pearly *Dew*, upon thoſe Plants and Flower
whence they were Extracted; or elſe the
congeal into a *white Froſt*, which aſperſe
the whole Face of the Earth with a Meal
Tincture.

The *Second* Effort of his Rays; finding th
Air begin to be warm, and the whole Face
Nature better diſpos'd to be wrought on, p
netrates deeper into the Earth, and draws the
ſpecifick Steams and Flavours out of Plan
and Herbs of every Kind; which are ſtill a
vanc'd, Inviſibly, to a greater Height, ti
they begin to ſubſide perceptibly into a Fo
of Particles of the ſecond Concretion; whic
ſubſides upon the Leaves of Trees, and upo
the Straws of Corn, in *Meldews* and *Hony-fa*
if the Air be calm, and the Wind diſperſe
'em not: Or elſe in Winter, theſe Balls
Dew (being now coupl'd into Pairs) becom
congeal'd into a *Hoar-Froſt*; which breaks th
more Uniform Motion of Light into a *Du*
Hazineſs.

The *Third* Effort fetcheth up the Eſſenc
of Minerals, and ſulphurous Exhalations, o
of the Bowels of the Earth, conjoin'd wi
Vapours of as different Sorts; which ſtill, u
on a greater Fall, grow into *Miſts*; or, whil
they hang ſuſpended in the Air, becom
Clouds, being driven into Heaps by the Win
while the Weather continues Fair; but upon

The *Fourth* Effort of the Sun's Rays, or other Lift by the Wind, the Weather changh its Complexion into *drizzling Showers*, orn'd with Rain-bows, while they remain quid; or into *Snow*, or *Sleet* of a Winterly ompoſition, mix'd with *Rain*; which, by e ſupervening Froſt, are Cemented togeer, glazing the Earth with *Ice*, and loading e Trees with *Snow* intermix'd.

At the *Fifth*, when both the Earth and the ir are impregnated with Heat, and jointly onſpire to reinforce this laſt Effort to the moſt, and raiſe thoſe Vapours and Exhalaons to the higheſt pitch; and put 'em beond the Reach of the Sun's Power to ſuſtain m any longer; they Fall at laſt, with the reateſt Speed and Precipitation, into *Shows of Rain*, or *Storms* of *Hail*, in a full Proortion as to their watry Part; leaving behind m the more Earthy Exhalations, of a more efin'd and more ſpirituous Extraction, to port themſelves in *Meteors* of all Sorts, in that Upper Region; which, by the Uneaſy crowdng together of their Heterogeneous Matter nto divers Situations, condenſe, and fall in s different Poſtures; and, taking Fire by heir Agitation, ſhoot into *Stars*, that vaniſh Each into a Line of Smoak; which (if it hapen by Day) leaves a *dusky Track* of Opacous tuff in the Air, of three or four Minutes Continuance behind it, Undiſpers'd.

Now, as to the different Manner of the Compoſition of *Rain*, and *Hail*; their firſt Ingredients are alike Inviſible Atoms, or Paricles of Water of the ſmalleſt Size; which make their *firſt* Concretion into a *thin Moiſture* by a ſcarce perceptible Deſcent; as ſoon as the ſupporting Beams of the Sun (being overpower'd by their Weight) begin to yield; and the leading Particles ſtill opening the Way for the Others to follow and overtake 'em; condenſe at the *ſecond*, into a *Fogg*, at the *third*, into a *Miſt*; and at the *fourth* and *fifth*, into Drops of *Rain* of ſeveral Sorts; ſtill increaſing their Size, and Precipitation, in Proportion to the Depth of their Fall; which is found by Obſervation to be conſiderably Greater in *Summer*, than in *Winter*.

But at their Converſion into *Hail*, the ſaid Inviſible Atoms of Moiſture are rais'd to a higher Region; where they are quickly penetrated by the piercing Cold, and ſoon congeal'd into a *Hoar-Froſt*; juſt as Ramenta of Steel become glowing hot in an Inſtant, by falling thro' the Flame of a Candle: And theſe frozen Particles beginning to Fall, are evenly ſpread upon the reſiſting Air, into Fleeces of *Snow*; which ſtill devolving Downwards, are rowl'd by the Wind into *Balls*; and drawing after 'em that Froſty Air, into a warmer Climate below; are, by degrees, as it were comfited into *Hail-Stones*, of a larger Size; and wrap'd in a Coat of a more Tranſparent, and *Icy* Conſtitution; as *Candles*, dip'd in *melted Wax*, put on a new Inveſtiture, upon every Immerſion.

Hence it comes to paſs, that *Storms* of *Hail* happen ſo frequently in *Summer*, when Heat abounds, to raiſe their Vapours to a competent Height; and ſo ſeldom in *Winter*, or Froſty Weather, for want of Moiſture to Ce-

t 'em together, as well as of Heat to
ſe 'em.

ut, becauſe the ſaid Vapours, as ſoon as
Congeal, begin to Fall ; and, ſpreading
Fleeces, haſten their Motion, till they
owl'd into Balls of *Snow* ; and are laſtly
ted over with *Ice*, in their Precipitation :
ſe which are Higheſt, and firſt undergo
e Changes, get an Advantage above the
t, both for *Size* and *Speed*, in Proportion
heir greater Deſcent thro' the warmer Air ;
, conſequently, muſt receive an Accre-
of the ſmaller Sort, which are Cemented
em in their Fall : Hence it is, that *Hail-*
es are *rugged* and *Multi-Angular*, and of a
lendent Brightneſs, contracted from as va-
s a Reflection of Light, (not *ſmooth* and
, like Drops of Water Congeal'd ;) which
l expreſſeth their different and manifold
mpoſition.

nd, whereas the ſame Storm commonly
rs down *Hail-Stones* of ſeveral Sorts, and
es ; and the larger and more rugged moſt-
all ſooner ; and the ſmaller and leſſer Sort,
rwards ; as being not able to pierce the
, and force their Deſcent with the ſame
ed : And, when the Storm begins with
il, and ends with *Rain* ; it is becauſe the
il, which cauſed that Precipitation in the
rmer and lower Region thereof, brought
Froſt enough down with it, to cauſe and
tinue a total and perfect Congelation.

Nay, ſo convertible are thoſe Watry Va-
rs, that compoſe *Miſts* and *Rain*, into
w and *Hail* ; and Theſe are again ſo reſol-
le into *Rain* and *Miſts*, that all *Four* are
ſometimes

ſometimes let Fall at once, out of the ſa Cloud, from their ſeveral Heights in the Ai and with ſuch Predominance either of *Hea* or *Cold*, which as differently affect 'em ; th while *Snow* is ſcatter'd on the colder *Tops* the Hills, *Rain* is often pour'd down into warmer *Valleys* below.

Or, on the contrary, after a Froſty a *Hoary Miſt* has long enſhrowded the Ea from the Beams of the Sun ; and they ha melted the Upper-ſide of it into *Rain* ; Showers, which were let fall, have no ſoon touch'd the *frozen* Ground, but have be Congeal'd, and glaz'd it quite over with and loaded the Trees with a Burden there ſcarce ſupportable : Thus Vapours, rais'd the Beams of the Sun, and let fall by the own Weight, are indefinitely diverſified in all Sorts of Weather, according to the Or nary Courſe of Nature ; and perhaps all the *Changes* may happen within the ſhort Spa of *eight* or *ten Days* : Let us ſee, how a *One Sort* of Weather can be of a longer Co tinuance.

SEC

SECT. III.

How Fair and Foul Weather interchangeably ſucceed Each other; and as diverſly affect the Sky, at different Seaſons of the Year.

SUCH is the Diverſity of *Hail*, and *Rain*, and ſo various is the Weather depending thereon, at all *Seaſons*; that it is impoſſible to affix any Sort of it to whatever *Time*, or *Place*; much leſs to continue it in the ſame State, upon reaſonable Grounds, for a whole *Summer* or *Winter* together. Yet, ſince it ſometimes ſo falls out; and previous Diſpoſitions, in a great meaſure, Occaſion it; and Theſe are beſt taken from daily Obſervation; I ſhall endeavour to draw a Scheme of the *Summer's Drought* in 1710, and How it broke; compar'd with that Memorable one in 1681, (*Three and Thirty* Years ago,) in Both Reſpects.

The great *Drought* in 1710, began ſo early as the *fifth* of *April*, and laſted, without any conſiderable Change, till near the middle of *June*; and perſiſted, without a Flood, till the beginning of *September*; the chief Diſpoſition for it being a wet and tempeſtuous *March*; which at once diſburthen'd the Sky of an exceſſive *Rain*, and ſettled the Air in a profound *Calm*; till towards the Month's End; when a cold *North-Weſterly* Wind congeal'd thoſe few Clouds, which remain'd undiſpers'd, into Fleeces of *Snow*, with ſome few *Showers* intermix'd; which left a *muddy* Sky for near a Fortnight within *May*; which *overcaſt* the Heavens daily, from *Ten* in the Morning till *Two* in the Afternoon; which the increaſing *Heat* of the Air ſtill rais'd Higher and higher, till it quite diſappear'd and vaniſh'd out of Sight.

This Serenity continued *ten* or *twelve* Days longer; the *Weather-Glaſs* keeping ſtedfaſt to its utmoſt Pitch all the while, to ſhew that the *Drought* of the Weather was then at a ſtand; till near the Entrance of *June*, that the Weight of the Vapours and Exhalations overcharged the Sky, and became abſolutely unſupportable: And that the Sun, having attain'd to the Height and Vigour of his *Summer's Solſtice*, was as loath to let 'em Fall; till the ſuppreſs'd Air began, as it were, to reel and ſtagger To and Fro, under the Burthen; as plainly appear'd, by the various and Irregular Motions of ſome *wandring Clouds*; which the *Barometer* alſo reſented by a correſpondent *Riſing* and *Falling*, yet near to an *Equality*; till thoſe Clouds were *overgrown*, and ſubdued the Reflection of his Rays; and forced the Returns of the *Sky* as well as of the *Quickſilver*, to decline gradually towards the *Falling* Side.

Yet they ſtoop'd not ſo low as to part with any Drops of *Rain*, till after many repeated *Deſcents*; and Then, Here and There, contingently; till thoſe Clouds were driven into *flying Showers* by ſudden Guſts of *Wind*, which ſtill attended 'em; and firſt they hit the *Ridges* of Hills, and *Heights* of Ground, that moſt oppos'd their Agitation; and thence drove down into the *Valleys*; where the Sun's Reflection was more broken and leſs able to ſuſtain 'em, than in the *Plains*; where his Heat was ſo ſtrong and Uniform as to *diſpute* their Fall ; and ſometimes *repell'd*, and *reſolv'd* 'em again into Atoms ; and ſo *over-haſtily*, and in ſuch Crowds, that their Concretions grew ſo *faſt*, and they fell again with ſuch *Precipitation* ; that they brought down with 'em from that *frozen Region*, at *Midſummer*, as ſharp Blaſts of Winds as uſually blow in *March* ; and as cold Showers of Rain, as fall in *September*.

And this Struggle between the *Heat of the Air* on the One Part, and the *Weight of the Clouds* on the Other, continued all *June* with an almoſt equal Succeſs ; and the *Impulſe* of the Latter was ſo warmly *repuls'd* by the obſtinate *Reſiſtance* of the Former, while *July* laſted, that they moſtly ſcatter'd *Miſts* inſtead of *Showers* ; nor did the *Rain* in *Auguſt* ſo entirely prevail over the *Drought*, as to cauſe a *Flood*, till near the middle of *September* : And after all, the Sky ſettled not into a Serenity ſuitable to the *Seaſon of the Year* ; but continued, as it were by *Counter-Libration*, thoſe Ups and Downs of *Hot* and *Cold*, with *wet* and *dry* Weather, which happen'd in *June* and firſt Occaſion'd 'em ; whereas the *Other* Memorable One began *later*, and continued *longer* ; and ſhut up the Summer's Heats with a ſeaſonable Rain and a great Tranquillity.

For the ſaid Droughty Seaſon, being deferr'd more opportunely till *May*, the Rain, which fell in *March* and *April*, had time enough to ſink deeper into the Ground, than to be overhaſtily extracted into Vapours by the Sun : Beſides, gentle *North-Eaſt* and *Weſt* Winds blew alternately all the while for his Aſſiſtance, to ſupport 'em, till the middle of *July*; and after they had got their full load of that Opacous Stuff; which, by obſcuring the Luſtre of his Beams and weakning their Fervour, reduc'd the Air to a *cooler* Temper; thoſe Winds alſo began to vary, and ſhift more *Southerly*, to let them Fall by degrees, and condenſe imperceptibly into an *Overcaſt*; which, finding the ſubſtrate Air too warm to admit it *Univerſally*, ever and anon roſe and clear'd up again, the Weather remaining *Dry* for all that Seaſon.

Till, at the Beginning of *Auguſt* it ſcatter'd ſome *flying Drops*, of too large a Size to be diſſolv'd and too heavy to be ſupported; as a Preliminary Diſpoſition to the enſuing *Showers*, which were put off a *Fortnight* longer; and the Wind, now *veering* conſtantly about the *Horizon*, with the Diurnal Courſe of the Sun, thro' all the Points of the Compaſs in *Four and Twenty* Hours; kept the Conſtitution of the Sky ſo *Equilibrious*, and thoſe Muddy Vapours ſo *evenly* ſpread over it; that, upon every Repulſe from the Earth, they were *reſolv'd* into Air in *two Hours* Space, and quite diſappear'd; without any Evacuation of *Rain*, to carry 'em off; or one Blaſt of *Wind* to chace 'em away.

Until thoſe flying *Drops* gathering together into *Showers*, and Theſe falling in with ſudden *Guſts* of Wind, broke the *Overcaſt* into *Clouds*; which reſpectively exonerated the Air, where it was heavieſt loaden in the *Firſt* Place, and ſucceſſively proceeded to exonerate the reſt; ſo that no where was miſs'd: And, in Concluſion, the Reſiſtance of the *Heat* below, being every where weakned alike by the *refrigerating* Showers, fair Way was made for a plentiful *Rain* to deſcend *Univerſally*, till the Sky was clear'd, and the Ground ſatisfied.

So *differently* broke this Surfeit of *Dry* Weather from the *Former*; and Both were ſo long continued, after as *diverſe* a Manner; and their *more and leſs ſeaſonable* Commencements as juſtly Occaſion'd it: The *Former* beginning in *April*, a Month too ſoon, and holding ſtanch no longer than *June*, contraſted a Change into *Foul* Weather with the Sun, upon harder Terms, when he was in full Power to reſiſt it; than the *Latter* (which was deferr'd till *May*) did in *Auguſt*; when his drooping Beams eaſily ſtoop'd to lay down their Burthen: So that the Quarrel which was ſtarted at the *Firſt* Change, and reviv'd at every Turn, in the *One* Caſe; was either wholly wav'd, or readily appeas'd in the *Other*.

Hence it is *Remarkable*: 1*ſt*, That, in both Inſtances, the Serenity began and ended with a *dusky* Sky, for *ten* or *fifteen Days* together; with an Interval of ſettled Weather for *five or ſix Weeks*; the precedent *Dusk* alike *beginning*, and the ſubſequent *ending* with *Rain*, which Occaſioned the Change.

2*dly*, That thoſe Clouds *roſe* every Day till *Noon*; and *fell* in the *Evening*, while the Fair Weather was coming on; being advanced by the *Morning*-Sun, and let fall by his *Weſterly Declination*; while the Air was cool, and the Earth moiſt to receive 'em: But, on the contrary, when the Serenity went off, the ſaid Cloudy *Overcaſt* ſtill *deſcended* from the Air's upper

Region, till the Sun's *Noonſtead Height* enabled him to repel it, whence it came.

3dly, That the *Riſing Overcaſt*, the higher it was advanc'd the thinner it became, and more *tranſparent*; till it quite diſappear'd: Whereas, on the contrary, That which *deſcended*, the lower it ſunk and the nearer it approach'd to the Ground, grew more denſe and *Opacous*, till it was repuls'd.

Laſtly, That how denſe and groſs ſoever this *deſcending Overcaſt* became, yet it was uſually clear'd off, by a Reſolution into its primogenial Particles, in *four Hours* Space; that is, between *twelve a Clock* and *four* in the *Afternoon*; having the remaining *twenty Hours* allow'd it to Compound again, before it was reſolv'd a *ſecond* time by the Sun, when return'd to the ſame *Meridian*: Till at laſt it was diſſolv'd into *Miſts*, *Showers*, and *Rain*; and the Serenity ceas'd.

Thus *Rain*, in both **Inſtances**, was Generated of *Vapours* rais'd by the Sun; which paſs'd and repaſs'd thro' all its *Degrees* of Concretion and Diſſolution, recounted in this *Section*, by the ſuperadded Tendence of its own Weight, within the ſhort Space of *four and twenty Hours*: The Weather continuing *Fair*, while they were ſupported by his Rays, in *Summer*: Now it occurs to enquire, How ſuch Weather can be ſettled in *Winter*, while his warmer Beams are withdrawn to a Foreign *Climate*.

SECT.

Sect. IV.

How the Weather becomes ſettled *in* Winter; *and changeth differently from what it did in* Summer.

FROM what has been ſaid already of the Change of the Weather in *Summer*, it plainly appears; that it is *Then* beſt ſettled (when the Heat of the Sun is predominant) by his *Support* of thoſe Vapours and Exhalations in the Air; which otherwiſe would diſcompoſe it: *Now*, on the contrary, the like Serenity is beſt preſerv'd, when thoſe Vapours and ill Humours are let *fall* to the Ground, and *ſuppreſs'*d by a hard *Froſt*; to breed no Diſturbance, till his warmer Beams lets 'em *looſe* again into ſome New Commotion.

For, to reſettle a *Winter's* Serenity, after the *Autumnal Rains* are Fall'n, no more is required; than that their Moiſture, after it is ſunk deep into the Ground, lie *Congeal'*d There, while he declines to his *Winter-Quarters*, to give the Air no Diſquiet; till his *reaſcending* Beams begin to rouze 'em up again, towards the *Spring*, into *Foggs* and *Miſts*; which the ſooner it happens, the Change of the Weather grows more *Tempeſtuous*; and the *Rain*, being groſſer, falls with greater Precipation; Or elſe, if the Seaſon be farther advanc'd, the *Froſt* commonly breaks into *Fair* Weather; the ſame Heat which raiſeth thoſe *Miſts* being enabled at once to *diſſolve*, and *ſupport* 'em.

Our laſt *Great Froſt*, and its *ſudden Thaw*, was a Memorable Inſtance of the *Former* Sort; which continued, with ſome Intermiſſions, from the Beginning of *November*, till the End of *January*; and, after it had enſhrowded the Earth from the Rays of the Sun, for *eight* or *ten Days*, with a thick *Hoar-Froſty* Sky, broke ſo on a ſudden; that the *Thames* was paſſable for *Coaches*, from *Weſtminſter* to *Lambeth*, in the Morning, and for *Barges* back again before Night; the Sun's Rays having warm'd the *Backſide* of that *Miſt* all thoſe Days (which was *congeal'd* before, and *floated* thro' the Minuteneſs of its Particles,) then (being made liquid) concorporated into ſeveral Concretions, and *ſunk* down apace, till it had *melted* all the Reſt.

Another Froſt, about *ten Years* before This, (which continued from the *fourth* of *February* till the *twentieth Day* of *March*) froze it ſelf out of the Ground, without *Rain*; the more enlivened Beams of the Sun, at *ſo far advanced a Seaſon*, ſtill carrying off the *Foggy* Vapours and *Froſty* Exhalations, as ſoon as they were rais'd; and leaving an Interval of a happy *ſeeding* (which was ſucceeded by an early *Harveſt*,) before any *April*-Showers fell to interrupt it; quite contrary to the *Other*, which broke in the *Depth of Winter*, with a *haſty Rain*; the Air being then groſſer and heavier, than the Sun was able to ſuſtain.

Thus *Fair* Weather is of Courſe ſucceeded by *Foul*; and cannot be long continued, in *Summer*, without an *Exceſs of Heat*, to ſupport thoſe Vapours and Exhalations which float upon our Air; nor in *Winter*, but by as *intenſe Cold*, to ſuppreſs 'em: But in the *Spring* and *Autumn*, when the *Equinoctial*-Sun ſtands Neuter, in Reference to thoſe diſagreeing Qualities; *Wet* and *Dry* Weather change alternately at every Turn of the *Wind*, without any Proſpect of Settlement; till either *May* gives the Predominance to the Former, or *November* to the Latter; and ſeldom without violent *Storms*, and raging *Tempeſts*; which, being *Compound Meteors*, conſiſting of *Wind* as well as *Rain*, they properly belong to the following *Section*; where *Both* are jointly diſcuſs'd, and their various *Phœnomena* are diſclos'd and Explicated.

CHAP.

CHAP. III.

Of the Production *of* WIND.

SECT. I.

The general Notion *of its Production.*

ALTHO' *Rain* (of which I hav already treated) and *Wind* (whic I now undertake), be compos'd o *Two different* Elements; yet the ſympathize ſo much in their *M* *tions*, that what I have ſaid of the *Generati* of the One, muſt *in part* be repeated, and ap ply'd to the *Production* of the Other; for, a *Water* is rais'd vertically, in the *Former*; ſo *Air*, in the *Latter*; and *Both* entirely, by th *Rays* of the *Sun*; notwithſtanding, as to th *Manner* of their Deſcent, they *differ* no leſs in regard the *Air* which they paſs thro', doe not tranſmit 'em alike; So that my preſen Endeavour muſt be mainly employ'd, to *com pare 'em* together all along my Diſcourſe; and ſhew at every Step, their *Accord* in the *One* Re ſpect, and their *Difference* in the *Other*.

Firſt, Concerning their joint *Accord*: A the firſt Active Stroke that the *Sun* gave in th *Generation of Rain*, was to extract *Vapours* out o of *Water*, by a Diſſolution of its Continuity into *ſmall Particles*; that by the *Increaſe of their Superficies*, he might hold it faſter, and raiſe it thro' the Air with more Eaſe: So, in the *Production* of *Wind*, he mingleth his pureſt Rays with the groſſeſt Air, which grovels upon the Surface of the *Earth*; to make it *Lighter*, by their Compoſition; and withal to *ſwell it* to a greater Height, *Spherically*; ſtill *Rarifying* it more and more below, and *Condenſing* it as much above, as the *Reflection* of his Rays either *Increaſeth* or *Diminiſheth*; and That is alſo renew'd by a daily Repetition; till at laſt they grow *too weak*, to ſuſtain ſo heavy a Load of Exhalations any longer; which then begin to *Fall* again, towards the Surface of the Earth, depreſs'd by their own *Weight*.

Secondly, Touching the *different Manner* of their Deſcent, the *Water*, whereof *Rain* conſiſts, being a much denſer and heavier Element, than *Air*, (the *Medium* thro' which it is to paſs,) every Drop thereof muſt pierce it with a *diſtinct* Hole; to diſtill its Showers *perpendicularly* towards the Surface of the Earth; whereas *windy Exhalations*, how groſs and heavy ſoever they be, yet ſtill retaining the *Natural Context* of that Element, they muſt drive the Subject Air *entirely down* before 'em; as the *Salt*-Flood repels the *Freſh*, when their *Currents* meet; and (the *depreſs'd* Air, ſtill making a more obſtinate *Reſiſtance*) that Part of it which is the *Uppermoſt* muſt *ſlip aſide*, to find an eaſier Paſſage *Downwards*; And the *faſter* it falls (always meeting with a *greater Reſiſtance*) it is ſtill conſtrain'd to deſcend,

ſcend, by a greater *Declivity from the Perpend* *cular*; till its Courſe arrives at laſt to a *Lev* and becomes *Progreſſive* ever after; the *wh* *Stream* of Exhalations purſuing the ſame *Tra* and *puſhing forward* all the while, till the common Stock be quite exhauſted: Thus th *Wind* is produc'd, by a *reciprocal Motion* of Ex halations; firſt *Aſcending perpendicularly*, an then *Deſcending* again ſtill *more and more* Ob *liquely* by degrees, till its Courſe becomes a laſt *Horizontal.*

And foraſmuch as the *Wind*, according t the *vulgar* Acceptation of the Word, is def ned, *A Flux of the Air*, which is the *Subject* o its Motion; in Reference thereto, it is to be

Conſider'd, *Firſt*, that Air is a *Heavy* Ele ment; as appears by the *Baroſcope*, which find the *pureſt* Sort Equilibrious to *ſeven and twent* *Inches* of *Quickſilver*; or ſo many *Foot* of *Water* and, conſequently, the moſt *natural* Motion of the *Wind*, in Compliance with the *Tenden* of its ſaid Subject, muſt be *Perpendicular*, to wards the Center of the Earth.

Secondly, the *Wind* being *rais'd Spherically* by the Sun, with due Reſpect to our Globe's Su perficies, muſt *Fall directly* towards its Center And being alſo *puff'd up* by the *Compoſition* o his Rays, muſt return back as *directly* whence it came (as Air returns in a *Cupping-glaſs* when the Flame is Extinguiſh'd,) as ſoon as they are withdrawn: Beſide, the *Reflection* of his Beams, being *ſtrongeſt* near the Surface of the Ground which they fall upon; the *windy Matter* muſt make the *ſharpeſt* return *Thitherward*: Hence the *deepeſt Deſcents* create the *briskeſt Winds*; as well as the *ſharpeſt Showers*.

Thirdly, To *decline* the Courſe of the Wind *obliquely*; as the *Rain*, that falls indifferently on all Places, alike *ſlides down on all ſides* into the Valleys, ſo does *Wind* into the ſame Depreſſions; and as *Rivers* of Water are *directed* by their *Banks*; ſo is this *Flux* of *Air* by the *Situation* of the Valleys, which it chanceth to fall into; the *One* Element, being as *naturally* inclined to follow the Conduct of its own *Weight*, as the *Other*; And *Wind* grows, by its deepeſt *Deſcent*, as it were into *Floods*, ſtill a larger and ſtronger Stream.

But on *Plains* and *Champion* Ground, where no *Depreſſions* are found to *ſway* its Courſe; as the *Heavier* and *denſer* Air (being *Uppermoſt*) forceth its Way thro' That which is *Lower* and *Lighter*; ſo the *Heavier Side* of any Part muſt draw the *Lighter* ſide-ways after it; or the *Weaker Side* of the ſubſtrate Air muſt *incline* it to ſlide down that Way; while Exhalations render it *unequally* Ponderous, by their *Compoſition*; or the Vapours, which attend it, *determine* its Indifferency by *Protruſion*: But, both the *Upper* and *Lower* Air being withal *Elaſtick*, the Motion of the One is *broken* diſorderly into *Blaſts* by the *Repugnance* of the Other, without End or Meaſure; while, for want of any ſuch *Determination*, the Wind runs *around*, at other Times, *in vain* to find one, till it be ſpent.

Laſtly, the *Sun*, which firſt ſtirs up this Tumult in the Air, by *Rarifying* it *below*, and *Condenſing* it *above*; draws it after him from

Eaſt to *Weſt*, by leaving it ſtill *Rarified* by h Preſence, for the *More denſe* to follow him b its *Preponderation* : All which ſaid Points o cur to be *diſcuſs'd* and *explain'd*, in the ſa Order that they are Propos'd.

SECT. II.

How Wind *is produc'd of* Air, *by the Moti and Mixture of the* Rays of the Sun ; *a How it is* directed *by the* Situation *of the Eart on which it falls.*

SINCE *Wind* Eſſentially conſiſts of a *Flu of Air*; and all Motion is conceiv'd to proceed from *Reſt* ; I am to ſuppoſe the Air t be ſettled in a profound *Calm*, before it begin to Move ; and ſhew how the *Rays* of the *Su* firſt diſturb its Quiet ; partly by the *Lightne* of their Compoſition, expanding and rariſying it, as it were, towards a *Vacuity* ; and partly by the *Activity* of their Reflection, *Buoying* up the Groſſer Part of it in the *Morning*, while their Light and Heat increaſe ; and letting it *ſink down* again into that Vacuity, when they are withdrawn in the *Afternoon* ; which ſufficeth to anſwer the *Wind*'s aforeſaid *Definition*.

Thus the Air is *rais'd* by the *Mixture* and *Activity* of his Beams upon the firſt Approach; and *falls* again Perpendicularly, as ſoon as they are withdrawn, by the Innate Propenſion of its own *Weight* ; but withal being exquiſitely *Liquid*, is as eaſily inclined to follow the different *Direction* of the *Ground's Declivity*, wherever it lights : Hence it comes to paſs, that the *Morning* and *Evening's* Air, conſtantly attends the *Riſing* and *Setting* Sun, with *gentle Gales*, upon the plaineſt *Flatts* of Ground, and amidſt the greateſt *Calms* ; breathing every where, and every Way at once ; and almoſt as *Imperceptibly* as the Riſe or Fall of *Dew* ; and ſcarce to be diſcern'd, but by the wafting *To* and *Fro* of the Flame of a Candle ; that, *Weathercock*-like, wou'd repreſent the Variety of its Motion.

But, upon a conſiderable Advantage of Ground, the *deſcending Blaſts* grow ſenſibly enliven'd ; and if its *Declivity* be increaſed in *Depth*, or *Compaſs* ; the *Wind* makes more haſte down it, and ſpreads it ſelf into a *larger* and *ſtronger* Stream, towards the *Falling* Side ; as *Foggs* are wont to ſwell, and ſubſide towards *Night* into the *loweſt* Situations, while the Sky is calm, and leaves 'em Undiſpers'd.

And, when they draw their Extraction from aloft the *Hills* which ſurrounds thoſe *Plains*, their *Celerity* is increas'd, in Proportion to their *Deſcent* ; and they ſlide down, ſucceſſively from all Sides, into the deepeſt Depreſſions ; where, like *Torrents* fed with many *Rills*, and thoſe alſo ſwoll'n with *ſudden Showers*, they *ruſh* headlong down the *Valleys*, into the *Plains* below ; and as it were *Overflow* 'em, with *Inundations* of Windy Matter ; like *Rivers* over-grown with *Rain*, when their Banks are broken down, and their Channels are incapable to contain 'em any longer.

But if it chance, that the Vapours and Exhalations, whereof the *Wind* is compoſed, *ſurmount* the *Tops* of thoſe *Hills*, whence they derive its Origin; They *rendevouz* there a while, with a great deal of *Indifferency*; till they be *broken* by their own Weight, upon the *Summits* thereof, into ſeveral *Parties*; and deſcend as *divers Ways* at once, into Streams or as *different Determinations*, according to the *Conduct* of the many Valleys, they fall into; whether down into the Plains *underneath*, or they be carried *farther off* into Foreign Countries: As from the Tops of the *Carpathian Hills* in *Hungary*; where the moſt Eminent of 'em, having ſcarce a Breathing Air *upon* it, gives a Beginning to the *manifold Streams* that gather, in the *Valleys underneath*, into *Floods* of Air, that become moſt violent and Impetuous.

Or, if the Tops of the ſurmounted *Hills* be *Ridged*; or many of them *continued* in One, the ſaid Maſs of Condenſed Air ſometimes *ſplits* itſelf into the *Two contrary Winds* only, which blow from each Side at once, towards the *Oppoſite* Points; as the *Eaſt* and *Weſt Winds* frequently do from that *Ridge of Hills*, which ſeparates *Lancaſhire* from *Yorkſhire*; by the Impulſe of the condenſed Body of Air, that diſchargeth it ſelf *Both Ways*, till ſome *Countermotion* of the Air *repel* it; the like being done by ſome *Hills* and *Winds* in *France*, and other Places.

Or, if the Form of thoſe Hills be *Pyramidical*, their Tops being *Piqu'd* and their Sides *ſmooth*; the Bodies of Wind which ſurmount 'em, being *pierced*, deſcend *every way alike*;

with ſo much *Indifferency*, that the Diurnal Motion of the Sun, rarifying the Air ſucceſſively before 'em, ſufficeth to draw 'em correſpondently from *Eaſt* to *Weſt*; from *Morning* till *Evening*, that He lets 'em fall; as is reported of Mount *Viſo*, that over-tops the *Alps*: And perhaps the *Wind*, being drawn ſo far as *One half* around it, may compel the Air on the Back-ſide of it, to blow the contrary Way along the *Other half*, to perfect the Revolution.

But it happens much Otherwiſe, when a ponderous Maſs of condenſed Air is *let fall* by the Sun from the Top of a High Mountain, without any ſuch *Predetermination*; as is done frequently, from the Top of *Parlock* near *Lancaſter*; where the *Wind* tumbles down into *Wyreſdale* with ſuch Precipitation, that, by its *Rebounds* from the Bottom of that Valley, it *remounts* the *Weſterly* Heights of Ground; and is carried aloft to near the ſame Height, till it fall into the *Sea* ſome *Miles* off; while the *Weſterly Gales* have blown *underneath* it, for ſome Time, the *contrary* Way; as appear'd by the Clouds, riding *Both Ways* at Once.

Thus out of a profound *Calm* is drawn a *Breathing Air*, by the Beams of the Sun mixing with it; which, being enliven'd by their Activity, firſt *aſcends*; and, after They are withdrawn, is *let fall* again by its Flux *downwards*; which gives it the Nature and Notion of *Wind*: And the *Reflection* of his Beams, being *ſtrongeſt* near the *Earth*'s Superficies, makes the lower Part of it *Lighter*, to incline it to fall; and withal more *Expanded*, to make room for its Reception: Now being thus diſpoſed, and exquiſitely *Liquid*, it muſt as eaſily follow the leaſt *Declivity*, where it Falls; and the *Higher* it is mounted, ſtill with greate *Precipitation*; and the *farther* the Valleys ar extended, either in *Depth*, or *Breadth*, ſtil grow into *greater Floods*, and Flow more *impetuouſly*, according to their *Direction*; as appear by thoſe *Inſtances* I have produced for tha purpoſe: Hence it is to be Concluded, tha *Wind* is nothing elſe but ſuch a *Flux of Air*, a I have deſcribed.

SECT. III.

How the Motion *of the* Wind *depends on the* unequal Poiſe *of the* Air; *and How its Flux* diverſified, *in its Paſſage thro' It.*

SINCE the *Wind* is defined a *Flux of th Air*, and the Air, ſo moved, is a ponderous Element, as appears by the *Baroſcop* (which makes the Weight of the *Atmoſpher* when it is *lighteſt*, equivalent to *ſeven and twenty Inches* of *Quickſilver*) no more is require from the Sun, to convert it into *Wind*, Than firſt to *Rarifie* the Air *more below*, by the Briſkneſs of the Beams near the Surface of the Earth and *ſwell* it up *Spherically*, by the Mixture o his Rays: And afterwards, by withdrawin 'em again at his *ſetting*, to *condenſe* it *above*, t make it Heavier, to *Fall perpendicularly* toward the Center, and ſupply the rarified Space lef behin behind Him: Juſt as after the enkindled *Flax* has expell'd the Air out of the *Cupping-glaſs*, it returns immediately, to repleniſh it again, after the Flame is extinguiſh'd: And withal, ſince the Sun *draws*, all the while, the ſaid rarified Space *after* him Tranſverſly, into the *West*, by his *Diurnal* Motion; the *Wind* muſt needs *follow* him *Thitherward*, to ſatisfie its above mention'd *Definition*.

§. 1.

Yet, notwithſtanding this *Eaſterly Determination* of the *Wind*; the Sun, to leave it *free* Liberty of Blowing from any *other Quarter* of the Heavens, in this our *Temperate Zone*, (where his Rays are weaker, and his Courſe of a ſmaller Compaſs than in the *Torrid*) and alſo to *direct its Motion* more effectually, from every Point of the Compaſs, on Occaſion; permits it either 1*ſt*, To follow the *unequal Poiſe* of its own Weight towards the *Heavier* Side; or 2*dly*, To fall into the *ſubſtrate Air*, where it is *weakeſt*, and leaſt able to ſupport It.

First, Concerning the *Former* Part: To give the the Motion of the Wind both *Force* and *Point*, at the ſame Time; the *Sun*, from his *Riſing* to his *Setting*, ceaſeth not to fill the Air with *Exhalations* and *Vapours*; which, conſiſting of *Earth* and *Water*, tho' divided into the *ſmalleſt* Particles, ſtill *preponderate* the Ambient Air, and preſs it *downwards*; as neither growing *Lighter*, nor filling a *greater Space* by their Separation: Again, That *windy* Matter being *diverſly* extracted, both for *Quantity* and

Quality,

Quality, Here and There, out of *wet* and *dry* Places ; muſt as *differently* affect the Incumbent Air, to move *Tranſverſly* ; and purſuant thereto, give the *Wind* as *various* a Propenſion towards all the Points of the *Horizon* ; and no leſs effectually Here, on *Champion* Grounds; than the Declivity of *Hills* and *Valleys* actually do in Other Places.

And, whereas *Exhalations* are ſo finely *intermix'd* with Air, as to give the *Wind* an *Interior* Tendence by their *Compoſitions* ; and *Vapours* are only *annex'd* to it, to impel it *Exteriourly* by *Protruſion* ; yet, foraſmuch as their *Natural* Propenſion, draws 'em Both *downwards*, They *jointly concurr* to the Wind's *Production* and *Conduct* ; ſeldom deſcending apart : After the One has *Open'd* the Paſſage, the Other ſtill making more haſte to *purſue* and *overtake* it ; and mutually propagate each Other : The *Wind* by condenſing the *Vapours* into larger Drops of *Rain* ; which, by growing greater, and falling faſter, on the Converſe, haſten the *Air* into *Wind*, to ſupply the ſame Space and reſtore the *Air's Equilibrium*, by their Precipitation.

Thus the Wind's *Indifferency* which way to Blow, is effectually *determin'd* by the *Unequal Poiſe* of its own Weight ; and its Flux is *directed* by the Uneven Support of the Air, which ſuſtains it : Now, altho' the *Paſſive* Part, thro which the *Active Wind* is to force its Way, be exquiſitely *Thin* and *Fluid* ; and more ſlippery than Ice, to let it *ſlide down* over It ; and as eaſily ſtoops to its *Preſſure*, on the declining Side, if *gently* Mov'd ; yet it grows *harder* by Compreſſion ; and *Obſtinate*, if it be urged with *Speed* and *Force*: And the Air (like *Water* mix'd with *Wine*, or *Balm* and *Oyl* with other Liquors) is never *quiet* and at Eaſe, till the Heavieſt Part be Loweſt ſeated; and all the Reſt in their proper Stations, to render the whole Body throughout *Equilibrious*: Hence it is, that, as *Rivers* of Water are confined to their *Channels*; and their Streams are *regulated* and *directed* by their Banks, *which Way* to Move, *whither* to Flow, and after *what Manner*; ſo, in our preſent Caſe,

§. 2.

Secondly, The *Flux of the Wind* muſt concede to the *Favourable Diſpoſition* of the *ſubſtrate Air*, in all thoſe Reſpects.

Firſt, If the *Airy Matter*, whereof the *Wind* is compoſed, be advanced ſo *High*, and the *ſubſtrate* Clouds prove ſo *groſs*, as to render its Motion perfectly *Level* before it reach the Surface of the Earth; it *hurries* thoſe Clouds along with it through the Sky, at near the *ſame* Height, at a mighty Rate; (Nothing that is *ſtedfaſt* or *ſolid* occurring, to *obſtruct* or *retard* its Career,) notwithſtanding the Rack may ride *underneath* perhaps *Tranſverſly*, or the quite *Contrary* Way, by Virtue of a like *Impulſe* from ſome *other Quarter* of the Sky; till all the ſaid Winds ſubſide into *Calmer* Weather: Or,

Secondly, In caſe the *Weight* of the *Wind* prevail, to *force* its *Deſcent* down to the Ground (as is uſual) *Obliquely*; it *rebounds* again into the Air at near the *ſame Angle*; and is *Reciprocally* brought down again, by its *Preponderation*, through the Ambient Matter; and ſo *Up* and

Down, with a kind of *Undulation*; moving forward (like a full-blown *Bladder* caſt upon a Marble Table) with progreſſive *Subſults*, till the Energy of its *firſt Impulſe* be ſpent.

Thirdly, If peradventure the *Deſcent* of the *Wind* be ſo *deflected from the Perpendicular*, as, at its Approach to the Earth, to *ſweep* the Plain, whereon it lights, with a ſmooth *Horizontal* Gale; yet preſently its Flux becomes diſorder'd, by its *Adheſion to the Ground*; which being fix'd, *retards* its Motion below; while the *Fluidity* of the Air aloft, devolves it with more Freedom, as to the *Upper* Part; which, like a *Bowl* caſt upon a Plain, moves forward with *Cycloidical* Furls, *one wrap'd within another*, till its Motion ceaſeth; which, like Waves of the Sea driven into ſhallow Water, tumble headlong *One over Another*, as if they ſtumbled upon a broken Bottom.

Fourthly, Though the *Flux of Wind* (all the ſaid Impediments being remov'd out of its Way) had *free Liberty* in other Reſpects, to blow to every Point of the Compaſs, without any *Difference*; yet it cou'd not *paſs forward* towards any of 'em *in particular*, without *ſlipping aſide*, and making its *Returns* To and Fro *alternately* at every Inſtant; the *Paſſive Air* ſtill making the *greateſt Reſiſtance* to the *Active Wind*'s Motion in a *direct Line*, where it is *moſt* Oppreſs'd: And the *Wind* being alſo in Readineſs, and well prepared to ſlip aſide into the *eaſieſt* Paſſage, it creeps forward with *Serpentine Windings*, without Intermiſſion: Hence the *Weather-cock* changeth its *Point* at every *Blaſt* while the *Wind* paſſeth on its Journey, as a *Ship under ſail* does its Voyage; which buſieth

th

the *Rudder* to keep it as cloſe to its *main Courſe* as is poſſible, yet never *ſteddy*.

Laſtly, Superadd to theſe manifold *Deflections* of the *Wind* the *Elaſtick Force* of the *Air*; and thoſe Streams, which have run *ſilent* and *continuous* all this while, are preſently broken into *rough*, and frequently *interrupted*, *Blaſts*; which grow more noiſy and tumultuous at every Turn; and upon any *Reſiſtance*, exert themſelves into *brisker Efforts*, to beat down all Oppoſition: And after *One Ruſh* is over, they take the Advantage of the *Calm*, to recollect their Forces and prepare for *Another*; and ſo for a *Third*, *Fourth*, *Fifth*, &c. while the *Tempeſt* laſteth.

Hence it is Obſervable, that in the *Calmeſt Air* and after the *longeſt Intervals*, they exerciſe the *greateſt Violence*; and make more *ſudden* and *ſurprizing* Eruptions in the *Beginning* of a Storm, when they are *moſt reſiſted*, than after the Air is render'd *compliant* with their Agitation; and ſtill they become more fierce, while it remains *clear* and *free from Vapours*, not to clog their Efforts: Yet never attain to the full Exerciſe of their Authority, till the *Air* (as in Wind-Guns) be *compreſs'd* alike by *contrary Blaſts*, on *all Sides* together.

Hence the Motion of the *Wind* is render'd ſo *various* and *inconſtant*, as not to be *traced* and *delineated* but by it ſelf; yet, 'tis repreſented more *viſibly* to the Eye, as it is *audible* to the Ear, or *tractable* to the Hand, by the concomitance of a *Train of Smoak*, chaſed thro' the Air by a *gentle Breeze*: By which, all the *Diverſity* of *Up's* and *Down's*, *To's* and

Fro's, *Backwards* and *Forwards*, are *drawn to the Life* upon the Canopy of Heaven: And, altho' they all proceed from the *Few Cauſes*, which I have already Aſſign'd; yet their Efforts run ſo *variouſly* and *contingently* intermix'd at every Turn; producing ſuch a *Diverſity* of odd and irregular *Poſtures*, and *Figures* of Inconſtancy; that no Licenſe of the *Painter's Pencil*, directed by the wildeſt Strains of *Poetical Fancy*, can reach to deſcribe it *at Land*: And

§. 3.

Concerning the *Winds* which are raiſed *at Sea*; They *wander* thro' the ſame Wilderneſs of *Inſtability*; its Superficies being ***Plain***, without any ***Eminences*** to give 'em Fall, or *Depreſſions* to direct 'em, like ***Breezes*** upon ***Champion Grounds***: And are mov'd ***To and Fro*** with ſo much ***Indifferency***, that if they be not *repuls'd* at their Entrance into *Creeks* and *Rivers*, by ſtronger *Land Winds*; they conſtantly *ſet into* 'em with the *Influx* of the Tide, and with its *Reflux* retire back again.

And if thoſe *Sea-Winds* conſiſt of ſtronger Blaſts, and be withal Outward bound; They are as much beholden to the Heights of *Rocks*, or Boldneſs of the *Shores*, for their *Force* and *Speed*, as if they had Blown at *Land*: And for their *Horizontal Determination*, they depend no leſs on the Flux of the *Streams* and *Currents* undernerneath, while they keep within the *Soundings*; than *Land-Winds* do on the *Declivity* of Hills, which give 'em Fall; and on the *Cavity* of Valleys, which receive 'em:

And are alike *diverſified*, with Reſpect to Both, as to their *Sorts* and *Sizes*, as long as they are contain'd within the Limits aforeſaid.

But, if thoſe Winds be rais'd ſo far off at Sea, that neither *Coaſts* nor *Currents* can increaſe their *Force*, nor influence their *Direction*; the Sun, by the *Uniform Reflection* of his Beams from the Ocean, performs *Both* no leſs Effectually; by raiſing an *Effluvium* of Vapours and Exhalations into the Air, in as great Abundance, while he is *Preſent*; and letting it fall down again in his *Abſence*, with as much Precipitation at Sea, as any where elſe: And by ſhifting his *Annual*, *Menſtrual*, and *Diurnal Motions*, their own Ponderation ſtill purſuing his Courſe, gives 'em an endleſs *Diverſity*, conjoin'd with an abſolute *Determination*; the Ocean's Superficies being *plain* and *ſmooth*, to open a *free* and *eaſy Paſſage* for every Blaſt, which the *rough* and *rugged Surface* of All things elſe as Obſtinately *reſiſts*; That makes them, at Sea, the moſt *conſtant* and *Uniform* of all Other, and to reach the *fartheſt Diſtance*; and with what *Variety*, more hereafter.

Finally, The *Wind* as well as *Rain*, both at Sea and *Land*, depends upon ſo many *various* and *Contingent* Circumſtances, throughout the *Temperate Zones*; that as thoſe *Showers*, ſpoken of before, were *diſpers'd* Here and There, by the Clouds, with an *indefinite Diverſity* of *Quantity*, *Quality*, and *Duration*: So their concomitant Blaſts of *Wind*, were proportionably *diverſified* in the ſame Reſpects: But add thereto this farther Conſideration; *viz.* That every ſmall Portion of *Air*, whereof thoſe Blaſts conſiſt, is *indefinitely Compreſſible*; on the One

Side, by what *drives* it *forward*; and on th Other, by what *reſiſts* it; and they muſt e ert their *Elaſtick* Effort, with ſo *different* Speed and Force againſt that *Reſtraint*; th perhaps no *Two* of 'em were ever the *ſame*, i *all* thoſe Reſpects, ſince the Creation: Now to add *Force* to their Variety;

SECT. IV.

Of the Production of Storms *and* Tempeſts.

ALL that has been hitherto Diſcours'd the Nature of *Wind*, and the ſever Determinations of its *Courſe*, is no more tha *Ordinarily* happens, on all Occaſions, in Reference to the *Poiſe* of its own *Weight*, *inclini* it to *Fall*; and the previous *Diſpoſitions of t* *ſubſtrate Air*, to *admit* and *direct* it, as to th Subſtance of its Motion: And, whereas have all along Treated the *Exhalations*, wher of it is compoſed, as *Principal*; and *Vapou* whereof *Rain* is made, only as *Acceſſory*: Bein now to deſcribe *Storms* and *Tempeſts*, whic equally conſiſt of *Both*, either *conjoin'd* or *apar* I am to reſpect 'em as ſuch: And, in Regar *Vapours* are *viſible*, and *Exhalations* are not; begin with the Former, to explain the Latt which are *inviſible*, as conſequent to 'em way of Explication.

Now, as thoſe *Rainy Vapours*, when, by longer Continuance of *Fair Weather*, they a *rais'd Higher* than Ordinary; as they are a

vanc

vanc'd in Height, ſo they are *enlarged*, and ſwell into Clouds of a *greater Compaſs*, from the daily Acceſs of *freſh Recruits*, and this *Viſibly*: We may infer, that their concomitant *Exhalations* do the like, and *Embody* themſelves, tho' after their *Inviſible* Manner: And as thoſe *Clouds of Vapours* ſometime grow to *Overcaſt* the Heavens; 'tis reaſonable to ſubſume, that theſe *Bodies of Exhalations* become *Co-extenſive* with 'em; even after *Both*, by their *greater Expanſion*, are vaniſh'd quite out of Sight: Whence it follows, that as thoſe *Clouds* become viſibly, 1. *Storms* of *Rain*; which Fall *ſuddenly*, and are *ſoon* ſpent: And that *Overcaſt* ſuits with 2. *Tempeſts* of a *longer Continuance*, and a *larger Extent*: So, by Parity of Reaſon, theſe *Exhalations* muſt *ſupply* both *Storms* and *Tempeſts*, as to the *Windy Part*: Let us ſee how the Operation is perform'd, in every Reſpect.

§. 1.

Firſt, Concerning the Production of a *Storm*: The *Vapours* and *Exhalations* provided for it, *begin*, even while they are yet *Inviſible*, to tend towards the Center of their *Gravity*, where the *Lines* of their Accumulation are the *longeſt*, and conſequently make the *deepeſt Impreſſion* into the Air underneath: And the Reſt *declining Thither* from all Sides *at once*, (as Water poured into a *Tunnel*, ſinks into its *Spout*,) they *multiply* their Concretions into the greateſt *Drops*, which *condenſe* at laſt into a *Cloud*: Where they are diſcharged headlong into a *Storm*, till (their Evacuation exceeding their Concretions) the *Alleviated* Air *ſhuts itſelf* up again; while *the reſt* of the Stormy Matter, which remains, tending towards *the ſame Place*, prepares it ſelf for *another* Eruption.

For, the *Firſt Effort* of the *Storm*, having carried off all its *Watry* Part that was *diſpoſed* for it, and every Drop, as it fell, leaving the Hole *ſhut* thro' which it paſs'd; the *Wind*, that purſued it before, is now *put to a ſtop*; and the Air is rendred *ſtanch* and *ſerene*, till the *Remaining* Stuff, which was left *unprepared*, tending to the *Center* of the *precedent Evacuation*, and crowding into a *Narrower* Compaſs, *repeats ſucceſſively* all the aforeſaid Concretions, till it be diſcharged after the *ſame Manner*, purſuant to the *Former*; and ſo a *Third Effort* ſucceeds the ſecond, and a *Fourth* the third progreſſively, one following another with the *like Intervals*; till the Sky be quite rid of all *ſuperfluous* and *troubleſome Matter*, to give the Air any *farther* Diſquiet.

And, in caſe the *Welkin* be diſpos'd to let *more Storms* fall, in *ſeveral* Places at the *ſame* Time, they breed no *new Diſturbance* in the Air, while they follow the *Courſe of the Wind*: But if they *vary* from it *divers Ways*, the Ambient Air becomes *tumultuous* on their *Occurrences*: And if their Motions prove *Adverſe* to one another, their Rencounters grow *more violent*; whether *ſo directed* at their firſt Eruptions, or induced, *by their own Weight*, to fall into ſome *Emptineſs* in the Air below; where they *Inſult* each other *ſo outrageouſly*, as, in their Congreſs, to *rid up Oaks by the Roots*; and *overthrow Caſtles*, by *ſhocking* the Earth and *ſapping their Foundations*: Nay, ſometimes *ſwallowing up* whole Armies, by *aſſaulting 'em* from the

Four Quarters of the *Heavens* at once, with an *irreſiſtible* Indignation.

When but *One ſingle Storm*, how *fierce* ſoever it be, ſets *againſt the Wind*, the Conflict is not ſo *ſharp*, being much *abated* by the Defendant, as the *yielding* Side; yet becomes more *Dreadful*, by the Addition of *Fire-Arms* to their Fury, eſpecially amidſt the Heats of *Summer*, while the Air is, on all Sides, impregnated with *ſulphurous* and *combuſtible* Matter; which Both Sides *ſweep together* in their Encounter; and by *compreſſing* it into a *Ferment*, and *overbeating* it by their *Agitation*, makes it take Fire, and diſcharge it ſelf in *Claps of Thunder*; which, being *involv'd* in the *manifold Furls* of the *Compreſſing* Clouds; each Crack breaking the Shell of its *Incloſure*, gives Fire *to another* of the ſame Rank, till *all* be diſcharged *in Order* at the Congreſs of their *Encounter*; as if the *Fronts* of their *Battles* fir'd their *ſmall Shot* upon each Other.

And if it ſo chance, that any of the *Cavities*, between the *Fronts* of thoſe *Embodied Clouds*, be not ſo *Enfolded* within the Reſt; but *directly Extended*, and as it were, *drawn out* into *long hollow Tube*; the Train of *Etherial Gunpowder*, incloſed therein, taking Fire at the *Upper End*, preſently diſplodes a *Thunderbolt* of moſt refined Matter out of the *Lower*; as uick as a *continued Rarefaction* and *Lightning* an drive it; and much ſwifter than a *Ball of Lead* paſſeth out of the Mouth of a *Cannon*; nd withal it is of ſo *ſubtle* and *penetrative* a Nature, and well fitted to do *Execution*, eſpecially where it finds *moſt Oppoſition*; as ſometimes to melt the *Sword* and ſpare the *Scabbard.*

This *Firſt Diſcharge* being over, preſently ſucceeds a *Second*; and this is back'd with a *Third*, *Fourth*, *Fifth*, &c. as long as their *common Store of Ammunition* holds out to maintain the *Fight*; for the *prevailing Storm* beating back the *yielding Wind*, and ſtill encountring the *freſh Supplies* of fiery Matter, while it brings up the *Rear*; They jointly fill the Air with *repeated Volleys of Shot*, till the *aſſailant Storm* be ſpent in the Purſuit; and the *defendant Wind* be ſo reinforced to *reſiſt* by its *Retreat*; that Both Sides after all are well content to acquieſce with a *drawn Battel*: The *Air's Equilibrium*, for which they engaged, being at laſt perfectly *Reſtored.*

§. 2.

Thus the ſtrongeſt *Storms* are ſooneſt ſpent, if they be not *prolong'd* by Intervals, before their *Supplies* of Matter be quite *Exhauſted*; and their *intermitting Fits* grow ſometimes into *Chronical Diſtempers* of the Air, when their *ſcatter'd Clouds* ſpread into *Overcaſts* aloft the Mountains, and become a *Boundleſs Ocean* of *Wind* and *Water*; without any other *Direction*, than to follow the *Propenſion* of their own *Weight* towards their *heavieſt* Side; or that which the ſubſtrate Air is *leaſt able to ſupport*: And, being once *ſway'd that Way*, they are carried down the *ſame Declivity* thro' the Air ever after; 1. Either according to *their own Breadth*; ſo, as at once to involve *whole Nations* in a Tempeſtuous Deluge; 2. Or only *in Part*, as following the *ſpecial Impulſe* of ſome *Exterior Agent* that *firſt* ſet 'em on foot; and that Part protruding *a Second*; and this *a Third*; the *ſame* Impreſſion is carried on to *the Reſt* progreſſively, as long as a **Train** of *the like Diſpoſitions* continues in the Air to *receive* and *encourage* their Motion. Now, in regard *Tempeſts* are commonly compos'd of *Wind and Water*; with *Flaſhes of Fire* intermix'd; and ſtill ſome One of 'em is *predominant* above the Reſt: Take here an *Inſtance* of every Sort.

Of the *Firſt Sort*, whoſe *chief* Ingredient is *Wind*, was *That horrid Tempeſt*, which ſome *Years* ago, raged ſo dreadfully in the *South of England*, and drove the Sea over ſo much Land in the *Weſt*, and threatned *London* with a greater *Devaſtation*, by the *Overthrow* of ſome Buildings, than was cauſed by *Fire* in the *great Conflagration*: And paſs'd afterwards *beyond the Sea* as far as *Denmark*. It muſt needs have been *fomented* and encouraged all that Way, by the ſame *Windy Diſpoſition* of the ſuperintending Air, which *firſt ſet it on foot* in *Cornwal*, near the *Land's End*, to *carry it forward* all the while till its *Stock* was ſpent, and the *Hurry* was blown over.

Of the *Second Sort*, which chiefly conſiſts of *Rain*, was *That prodigious Storm* of *Hail* (or *Rain ngeal'd*) which paſs'd ſoon after, on the 29th of *April*, thro' *Lancaſhire* and *Yorkſhire* in *two Hours* Space, from the *Iriſh Sea* to the *German Ocean*; pouring down *Stones* all that way of *ght* or *ten Inches* Circumference, and ſome *ght* or *ten Inches* long; and of all *Shapes* and *gures* imaginable, to the great Wonder and

Aſtoniſhment of the *Beholders* : Such was the *Favourable Diſpoſition* of the Air all along for thi *Storm*, as to *continue the Impreſſion* of its firſt Impulſe, according to the *ſame Direction*, from *Sea* to *Sea* ; the *Motion* of the *Wind*, as it paſs'd from the *One* Extreme to the *Other* in ſo *ſhort* Time, being next to a *Calm*.

And as to the *watry Vapours* whereof *the Storm* conſiſted, they being *driven*, at their firſt Concretion, *diſorderly* into *Unequal Heap* by tempeſtuous Blaſts of Wind ; And again ſuffering a *more irregular* Compoſition by the Shock of *Thunder* ; concorporated in their Fall into *greater* and *more unequal* Balls of *Moiſtur* as long as they remained *Liquid* ; but drawing after 'em a *froſty* Air, they became *Congeal'd* and after that, being precipitated into a moiſter Region below, were *Cemented together* into an *Icy* Conſtitution ; and became Form'd as they *grew larger*, into the *Oddeſt Shapes* that *Precipitation* and *Chance* cou'd poſſibly occaſion.

Laſtly, That *ſtupendous Commotion* in the Air, which ſo much damnified *Holland* that it blew down *all the Steeples* in *Utrecht* (that of the *Cathedral* only excepted,) and reduced the *Body of the Church* to a Heap of Rubbiſh ; and endanger'd *Amſterdam* to the ſame Fate : As it *alike* conſiſted of *Vapours* and *Exhalations*, with the *Storms* of the *Two former Sorts* ; ſo it was *diſtinguiſh'd* from 'em by additional *Flaſhes* of *Fire*, and *Smoak* ; to expreſs in *Thunder*, *and Lightning* the utmoſt Fury that *Fire* and *Water* cou'd exerciſe upon one another ; and *Both conjoin'd* upon all things elſe, in order to their *Deſtruction*.

Now, to *diſtinguiſh*, after ſome manner, a *Storm* from a *Tempeſt*, which alike proceed from a *Stagnation* of *Vapours* and *Exhalations* intermix'd: The Former ſeems at firſt to *break out* of the Sky thro' a *ſmall Cloud*, as it were out of a *Bottle* of a *narrow* and *contracted Orifice*; but preſently *ſpreads itſelf* to a *greater Compaſs*, and diſchargeth its Fury with *ſo great Violence* and *Precipitation*, that it is *ſoon over*: But the *Tempeſt* ſlides thro' the Air with *a ſloaping Declivity*, as one *Plain* does off another upon the *like Declination*; and becomes of a *longer Continuance*, and *larger Extent*: Yet *Both* are agreed to follow ſome *previous Determination*, to *direct* their Motion *forwards* progreſſively: Whereas, on the contrary, the *Spout* and *Hurrican* always *begin* with a *Calm*, and *end* in a *Circumgyration*; according to the *Remarks commonly made* upon 'em; and which are laid down at large in the Enſuing *Section*.

SECT. V.

Of the Production of Whirlwinds, Spouts, *and* Hurricans.

HAving conſider'd the *Motion* of the *Wind*, as being either *conducted* by *the Courſe of the Sun*; or *byaſs'd* by the *unequal Poiſe* of its own *Gravity*; or *drawn aſide* by the *Declivity* of the *Surface* of the *Ground* whereon it falls: It *remains* to Enquire, to *what Point* of the *Com-*

paſs it wou'd ſteer its Courſe, in caſe of a *pure Indifferency* in all thoſe Reſpects; which may happen in a *Calm*, upon a *Plain*, in a *Summer's Morning*.

In this Caſe it is to be *Obſerv'd*, that as ſoon as the *Riſing Sun* begins to warm the laſt *Evening's Dew* into a *Morning's Miſt*; if the Ground, *whence it is rais'd*, be throughout of the ſame *wet* or *dry Conſtitution*; the Air grows by Degrees *groſſer* and *more Opacous*, in the *like Proportion*, without any other Diſcompoſure: But if, on the contrary, it be *variouſly interſpers'd* with *Lakes* or *Boggs*, to charge the Air *unequally* with their *Effluviums*; it ſeems to become ſomewhat *Uneaſy*, fleeting gently *To* and *Fro*; and advancing *higher* into a *cooler* Region, begins to break into the *ſeveral* Conſiſtences of *Vapours* and *Exhalations*; and the more *ſubtle* and *Aqueous Part* ſtill *Aſcends*, and Rarifies into the *purer Air*; while the *groſſer* and *Terreous Matter* ſinks alike in it, being *condenſed* by its Refrigeration.

And withal, being *contracted* into a *leſſer Compaſs*, thoſe Exhalations *ſeparate* into *diſtinct Bodies*; as having been *diverſly* furniſh'd from the *adjacent Places*; and being Becalm'd *turn round* in vain, to find out ſome *ſpecial Direction*; while their devolving *Spires*, by haſtning their Deſcent (*Periwinkle*-like) *draw* each into a *narrower Compaſs*; and *twiſt* themſelves at laſt into almoſt ſo many *Points*: But when they reach the Bottom, they *unfold* themſelves and *ſpread* again *ſpirally*; and Thoſe which fall upon *Water*, according to their *different Incidences*, draw as great a *Diverſity of Figures* upon its Superficies, running through all the *Conick*

Sections: While thoſe which fall upon *Land*, pick up *Leaves* and *Sticks*, Here and There, in the *Woods*; and *Straws* and *Stubble* in the Fields; which they *ſcatter* and *diſperſe* again, with as irregular a *Diverſity* of *Curvilinear Motions*; till the firſt ſupervening *Blaſt of Wind* carries off the *Scene*, and ſpoils their *Sport*.

But if the *Calm* happens to continue, till thoſe *Miſts* be drawn up into *Clouds*; and theſe again be *Evaporated*, as to their *watry Part*, into *Air*; Each of them leaves in the Sky a *dusky Obſcurity* of *Exhalations*, of a more *inſeparable Compoſition*, behind it; which, being *more ponderous* than the Common Air, *ſinks* a while, *Perpendicularly*, down it; till the *ſuppreſs'd* Part growing *more Condens'd* below, and making a greater Reſiſtance to their Deſcent; Thoſe *Embodied Exhalations* are forced to *ſlip aſide Obliquely*, to find an *eaſier* Paſſage Downward: But which way ſoever they tend, ſtill meeting with more Reſiſtance, they *deflect* their Courſes more and more *towards the Center* of their *Gyrations*; where, the Motion being *ſloweſt*, their Matter becomes *moſt ponderous*, to draw 'em *Thitherward* till they become *Circular*: And the *leading Part* of each Diviſion, *drawing* down after it its *concomitant Body* of Exhalations (*ſpirally*,) by the ſame *vertiginious Tract*, they become ſo many *Whirlwinds*; which *increaſe their ſpeed* at every Turn till they reach the Ground: And then being *determin'd*, either by ſome *previous Declination* of the *Air*, or by the *Declivity* of the *Earth's Superficies*, whereon they fall; they move *forward* with a *progreſſive Circulation*, ever after; juſt as *Straws* or *Leaves* caſt into a *Whirlpool*, contract the ſame *vertigi-*

nous Motion, and continue it *down* the Stream *progreſſively*, till they be quite Diſpers'd.

Thus a *ſmall Quantity of Moiſture*, hois'd up into the *Sky* and let fall down again, becomes a *Whirlwind*; but, being only the Production of *one Morning*'s Sun, eſpecially at *Land* and in Our *cool* Climate; it wants both *Height* to Fall, and *Weight of Vapours* to drive the Air into any farther Diſorder: But, on the contrary, at *Sea*, where the *Surface* of the Water is throughout *Uniform* to yield an *equal Supply* of Moiſture *on all Sides* at once; They muſt, upon a longer Continuance, ſpread *more evenly*, like a *Canopy*, over the whole Face of Heaven; and be of *too large* a Compaſs for the ſaid *Whirling* Motion; and for want of other *Determinatio*, as an Unſupportable Load, muſt at laſt *break down* a Sallyport by *main Force*; and Tumultuouſly *ruſhing into it from every ſide*, muſ croud themſelves into a *Spout*; and diſembogue their Stream down a *Pillar of Water* into the *Sea*; till the Tumult ſurceaſing for wan of a *farther Supply*, the *Top* of it (which befor ſeem'd to reach the Heavens) is *let fall* at laſt and Immers'd in the Ocean.

Hence it is *conſtantly obſerv'd*, that, for *ſe veral Days* before the *Spout* chanceth to fall the Surface of the *Sea* continues *Smooth* an *Even*, to furniſh more Vapours by its *unifor Reflection*: Beſides, the *Air* remains profoundl *Calm*, not to drive 'em into irregular *Heaps* o *Clouds*, and occaſion their *untimely* Fall: More over, the whole Face of Heaven appea *Serene* and *Clear*, not to hinder the Motio of the Sun's *Light* or *Heat*, from *raiſing* 'em t thei their *full Height* ; and *holding* 'em *ſteady* throughout their *Expanſion* over the whole Firmament, their *Burden* is render'd throughout *alike* ſupportable, by the *Equality* of their *Diſperſion* ; and every where *Inviſible* ; till at laſt growing *too Ponderous*, and the Sun's Beams *too weak* to ſupport 'em, a *Breach* is made ; and, *all* crowding thither, they *condenſe* into a *Cloud* ; and are hurried into a *Spout* by their *Precipitation* ; the *leading* Part drawing the whole Maſs of Vapours *after* it ; till the *oppreſs'd* Air be quite *diſburthen'd* of its Load ; and that vaſt *Expanſion of Vapours*, that oppreſs'd it, be Exhauſted.

To deſcribe the *whole Appearance*, according to *Obſervation* ; before the Cloud (which is an infallible *Prognoſtick* of the *enſuing Storm*) be *viſible*, is diſcern'd a *dusky Obſcurity* in the Sky of a *thin Rain*, haſting *from all ſides* towards the *Center* where it is to fix ; and the *Sea's ſuperficies* becomes *plain* underneath through the Preſſure of the Air, which deſigns the *Compaſs* wherein it muſt Fall ; which ſoon *grows rough* again, with the *Diſturbance* that attends it ; and contracting the ſame *whirling Motion*, condenſeth the *preliminary* Drops of the *Storm*, (which before were *thin* ſcatter'd by their *Gyration*) into a *thick* ſort of *Rain*, which ſeems to *aſcend* out of the Waves : As a *Fogg* which falls on a *Summer's Evening*, condenſing firſt below, *ſeems to riſe again*, though the Vapours which augment it, *really deſcend* all the while : And the ſaid Cloud, *ſtooping* from above ſtill lower, meets the *Other* which *ſeems* to riſe ; and they both *concorporate* at laſt into a *Pillar of Wind*, and a *Stream of Water* intermixt ; which *ſpreads* itſelf more and more upon the Surface of the Ocean, *Spirally*; as long as their common Stock of *Vapours* and *Exhalations* can hold out to maintain it.

Such Defluxions or *Cataracts* of Water from the *Sky*, are commonly call'd *Spouts*, from their *Watry* Compoſition, and *Perpendiculars* for their directer *Tendence* towards the *Center* of the *Earth*; while others, which are of a more *Airy conſtitution*, are as properly named *Hurricans*, from the *irregular* Diſorder and *Fury* of their Motion; as conſiſting moſtly (if at *Land*) of *hot* and *dry* Exhalations, and *ſulphureous Steams* of Minerals; and are ſo *impregnated* with the *Beams* of the *Sun*, as to *Ferment* and *take Fire* upon every ſmall Agitation: Or, if they be raiſed *at Sea*, the *brackiſh Vapours*, that are exhaled from it, ſoon become a *ſultry Air*.; which, *alike* intermixt with his Rays, become a *combuſt Matter*; and at every Turn, ſend forth *Lightning*; which, being involv'd in the *ſurrounding* Clouds, upon every Eruption, make *Claps of Thunder*; which are diſcharg'd, *in Peals*, one upon the back of another, after a Furious and dreadful Manner.

To *calculate* in ſome Meaſure, the unconceivable *Fury* of this *raging Meteor*, from the Maſs of the *Matter* whereof it conſiſts, and the *Height* whence it deſcends: The *Former* probably extends to *a hundred Leagues* in compaſs, and to a *Depth proportionable*; which, having made a Breach *through the ſuſtaining Air*, crowds it ſelf into that *ſmall* Cloud call'd *Ox-Eye*, by haſtning thither *on all ſides at once*; and *condenſed* into an unſupportable Load, *forceth its Way* through that narrow Paſſage *downwards*, for a *Thouſand* or *Fifteen Hundred* Fathoms; as from the *Top of the Teneriff* down into the *Sea*; accelerating its *ſpeed* all the while, perhaps to equalize that of a *Flaſh of Gunpowder* out of the *Mouth of a Cannon*, and be able to do the ſame Execution.

And *deſcending* all the while through a *Medium* impregnated, at ſo *ſultry a Seaſon*, with *ſulphurous* Matter, drives it on *Heaps*, and *involves* it within its *ſpiral Folds*; till, either *compreſs'd* by ſo *cloſe* a Confinement, or *overheated* by too much Agitation, it takes Fire, and diſchargeth it ſelf in *Thunder* and *Lightning*, into *Clouds of Smoak*: And, after it reacheth either *Land* or *Water* to *obſtruct* its Courſe, it *fulminates* at laſt, to *break down* all Oppoſition; either by *main Force*, if it be erected of *Stone*, or dug out of *Quarries*; or elſe *diſſolves* the moſt ſolid and compact of *Metals*, by the *acuteneſs* of its Parts, and by *Menſtruums* proportion'd to their *ſpecifick Natures*; according to the *different Qualities* of the *Minerals* whence they are extracted.

And, to continue the *Storm*, leſt the *Force* of this fiery *Meteor* ſhould *abate* by a *greater Expanſion*; its *unfolding Spires*, by *encompaſſing* more Air, ſtill takes in *new Matter*; which ſerves for *Fuel* to increaſe the *Flame*, as long as the Ethereal Exhalations hold out to *purſue* its Courſe, and *furniſh* it with *freſh Recruits*; and the Tumult *ceaſeth* not, till the Air's *Magazine* be *drain'd* of ſuch *ſulphurous Matter*, for a conſiderable Compaſs.

Concluſion.

THUS the *Spout* and *Hurrican* are *rais'd* alike, by the *laſt* and *ſtrongeſt Efforts* of the Sun's Rays; the *Former* conſiſting chiefly of *cold* and *moiſt Vapours*; and the *Latter* of *hot* and *dry Exhalations*: and *at Land* they are commonly extracted according to their *different Conſtitutions*; the One, out of *dry* and *deſart* Places, where *Sulphur* moſt abounds; and the Other out of *Boggs* and *Fenns*, where *Moiſture* is predominant: And *at Sea*, where *Salt* and briny *Vapours* are exhaled, in the *greateſt Meaſure*, and for *the largeſt* Extent; the Air remaining *Calm* all the while, to receive 'em *Evenly*; and *Undiſturb'd*, not to drive 'em into *Heaps*; the Sky being throughout *Serene* and *Clear*, to leave the Sun the free Exerciſe of his *Heat* and *Luſtre*; and withal to *Advance* and *Support* 'em at the *higheſt* Pitch, over the whole *Expanſion* of the Firmament, as far as it is Viſible; and this both according to *Reaſon* and *Obſervation*.

Hence it comes to paſs, that off the *Coaſt of Guinea*, at *four* Degrees *North Latitude*, where there is almoſt a *perpetual* Calm, *Spouts* moſt abound; eſpecially in *Auguſt*, when the Sun is *vertical*, and his Rays *perpendicular*, to draw up a *greater Quantity* of Water, and *ſupport* it *longer* at its greateſt Height: Again, at the *Caribees*, where *Iſlands* lye *thick* in the Sea to furniſh an abundance of *Exhalations*, as well as *Vapours*; after the *Trade-wind* is leſſen'd gradually into a Calm, the Sun raiſeth the *fiercest Hurricans*, conſiſting alike of *Air* and *Water* ; and, altho' they fall not *Periodically*, at certain *Seaſons* ; yet always, when the *Calms* are *more frequent* than ordinary ; and thoſe *Tempeſts* that uſually rage on the Coaſt of *Coromandel*, and the *Southerly Iſles* in the *Sea of China*, ſo conſtantly fall at the End of the *Weſterly Monſoons*, that they are commonly call'd *The breaking up of the Monſoons* ; ſo that *every where* a *Calm* indiſpenſably attends 'em.

And it is to be farther *noted*, that thoſe *three* Places, tho' moſt obnoxious to *Spouts* and *Hurricans*, yet they are *ſeldom* found in their *Confines* ; as in the *Gulph of Arabia*, where the *Monſoons* intermit not, tho' it be continued to that of *Coromondel* ; nor amongſt the *Antilla's*, where there is commonly a *Southweſt* Wind, tho' they lye next adjoining to the *Caribee Iſlands* ; nor upon the *Equator* on the aforeſaid *Coaſt of Guinea*, where there blows a ſtrong *Weſterly* Wind almoſt perpetually : ſo that where there is no *Calm* there is no *Hurrican*, let all *other Diſpoſitions* for it be what they will.

And as for thoſe *Spouts* or *Hurricans* that happen out of the *Tropicks*, where the Sun's Rays are leſs able to *Raiſe* and *Support* 'em at a conſiderable *height* in the Air ; they moſt commonly *Aſcend* by ſuch *heights of Ground*, as are *prominent* to thoſe Seas ; as near the *Cape of Good Hope*, and the *Pique of Teneriff*, that their Vapours and Exhalations may *climb up the Hill* with more facility, having the one Foot *fixt* upon it, than to mount *properly* of themſelves into the Air ; and thoſe which at firſt make the *leaſt Appearance* in the Air, as being *higheſt* *mounted*, ſtill become by their *greater Fall*, t moſt *Furious* and *Dreadful*.

Nor can it rather be imagin'd, that t Force of any *Rarefaction* made in the Air c diſplode ſo *ſudden a Puſh of Wind*, as to drive *Hurrican* into ſo tumultuous a Diſtraction or that *Eolus* had bagg'd up thoſe Blaſts i *Caskets of Leather*, till, *all on a ſudden*, th broke ſtitches with their *Incloſure*; yet th *Down-fall* from ſo great a *Precipice* does na rally occaſion it: Or that a *Whirlwind*, b ſome *violent Concuſſion* of the Sea, hoyſeth u ſo many *hundred Tuns of Water* in ſo *ſhort* Space, to feed the *Spout*; rather than tha *Triton* laves 'em out of the *Ocean*, and *Bott* 'em up till their Veſſels *burſt*: Whereas t Sun's Rays draw 'em up *diſpers'd*, till th *Confluence* brings 'em down again *at leiſure* a *with Eaſe*: Nor that any *other Reſervatori* either of *Wood* or *Stone*, beſides their *unifo* *Expanſion* over the Firmament in *minute Pa* *ticles*, lodges 'em *inviſibly* there, till their Mea ſure be *compleat*: ſince neither *Wind* can p ſibly *raiſe* one diſcernable drop of Rain, n the Air *hold it* ſtedfaſtly up, for *one ſingle M* ment, without letting it ſlip through their Fi gers.

Such is the *Affinity of Rain and Wind* in g neral; and their reſpective Motions are *nearly related*, that the *Generation* of the O moſtly becomes the *Production* of the Othe the *ſame Operation* of the Sun's Light and He commonly ſerving to effect 'em *both*; rai jointly their *Vapours* and *Exhalations* as *bi* and ſuſtaining 'em as *long* as the Force of can hold out to *ſupport* 'em : But after they are beholden to the *Declivity of*, to *direct* their ſeveral Motions ; and to *Concavity of Valleys*, to give their *Showers* *Blaſts* a *different Conduct* : And, as for the *ſick Diſtinctions* of *Storms* and *Tempeſts* ich are higher mounted,) on the One ; and of *Spouts* and *Hurricans*, on the er ; I have ſufficiently ſhewn, how the *mer* are eaſily reduc'd to, and explicated by ourſe to the *unequal Byaſs* of their own *vity*, or the *uneven Yielding* of the *ſupporting* : And that the *Later* contract their *whir-* *Motion*, purely from the *Want* of any ſuch *al* Determination : So that it only remains, *Illuſtrations ſake*, to bring the Truth of t has been already concluded of the *Ac-* *of Rain and Wind*, by *Reaſon* ; to the Teſt plain *Senſe* and daily *Obſervation*.

SECT. VI.

n and Wind Accorded *by the* Weather-glaſs.

NOW to ſhut up the whole Account I have given of the Production of *Rain* *Wind*, in the Two laſt *Chapters*, with One *itular* Cloſe ; To *illuſtrate* all that I have upon this Subject, by bringing it to the of our Senſes and Experience, 'tis expedi- to conſult the *Baroſcope* : which, as an l *Balance*, by weighing the *Air* in one of the *Scales*, againſt a Counterpoiſe of *Quickſilver*

Quickſilver in the Other, plainly ſhews t *Ponderation* of the *Atmoſphere* at all times , an conſequently how our *Theory* of the Sun's ra ſing *Water* into *Vapours*, and *Air* into *Exha tions* ; and letting 'em fall again into *Rain* an *Wind*, correſponds with the Riſe and Fall the *Quickſilver*, as being their proper Effec

Firſt, We find by Experience, that af the *greateſt Evacuation* of the *Air*, the *Quic ſilver* ſtands to 27 Inches ; yet, as ſoon as t Heat of the Sun raiſeth the leaſt Fogg Miſt, it preſently reſents it with a *Blebb* in t *midſt* of its *Tube* ; where it has *moſt Liberty* riſe within it ſelf, before it has got Streng to loſe its *Adheſion* to the Sides of the *Tub* but when the Heat *abates*, it returns to its *fo mer Level*, by the Depreſſion of its own Weigh and ſinks lower into a *Dimple*, if the Ai Evacuation continue ; which ſerves for *ſtinctive* Remarks of *Fair* or *Foul Weather* enſue ; but a *ſudden Shock* of the *Tube* reſto it *either* Way, to the true Height of the *pre* Seaſon.

Secondly, When the Sun, by his *repea* Beams, redoubles his Force, and adds a *reſpondent* Quantity of Vapours and Exhala ons to the *Former* ; and withal, raiſeth 'e *jointly* to a *higher* Station ; the *Quickſilver vanceth* in the *Tube*, in *both Reſpects* at on in the *ſame* Proportion ; as a daily *Progno* of fairer Weather ; which is no ſooner continued, than thoſe *Fogs* and *Miſts*, that appear'd, become *Rain* and *Wind*, by th *higher Fall* and *deeper Deſcent* ; which the *Qui ſilver* farther reſents at a correſpondent Ra

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ith a *longer* Deſcent and *greater* Precipita-
ion.

Thirdly, In regard the Conſtitution of the
Air is *Fluid*, and the Vapours and Exhalations
herewith it is charged, *Heavy* and *Ponderous*;
nd by conſequence, the *Superficies* of the *At-*
oſphere, which they compoſe, naturally *Even*
nd *Level*; ſo as not to lye *parallel* to the Sur-
ce of the Earth *underneath*; which is ſolid
nd *rugged*, and ſtill *more depreſs'd* towards the
. Hence it is, that the *Quickſilver* ſtands
heſt in the *Baroſcope*, when 'tis *neareſt* to
Shore; as ſupporting the *Longeſt* and *Hea-*
eſt Column of Air, in proportion to the in-
eaſe of the *Thickneſs* of the *Atmoſphere*:
ence we find *there* the *ſharpeſt* Wind and
oſt *intenſe* Rain, as falling down a *greater*
ecipice.

Fourthly, Whereas it is again found by Ob-
vation, that the *Quickſilver* never *aſcends*
gher than 31 *Inches*; nor *deſcends* lower than
, be the *Situation* of the Place what it will:
e have the *Weight* of the *Atmoſphere*, as
ply conſider'd; and the *ſuperadded* Load of
pours and Exhalations, *Geometrically Stated*
d *Compared*, as 4 to 27; the *mean Space* be-
een 'em ſerving for a *Scale*, to meaſure the
veral Degrees of *Fair* and *Foul Weather*, as it
ere by *Inches*; and (were the *Bore* of the
ube *enlarg'd*, and fill'd with *Water* inſtead of
uickſilver) it wou'd weigh the *different Ponde-*
ions of Air at their ſeveral *Seaſons*, as it
ere by *Ounces*, with the *greateſt* Exactneſs.

Fifthly, In conſideration that the ſaid Va-
urs and Exhalations, whether they *Aſcend*
Deſcend, ſtill retain the *ſame Weight*, as con-

ſiſting of a *like* Portion of Matter ; yet *dif*
rently affect the *Baroſcope*, and more in *Fa*
than *Foul* Weather ; as being eaſier to *ſuſtai*
any portion of Weight than to *raiſe* it ; an
again to *let it fall* than *ſuſtain* it : Beſides, an
quantity of Matter, by a *repeated* Diviſion *i*
creaſing its Surface, and becoming *more Ten*
ble ; the Rays of the Sun (while thoſe Vapou
and Exhalations retain their *inviſible Size)* ca
hold 'em faſt : But when they begin to *com*
pound together, as growing too compact to b
ſupported any longer, and thereby *Alleviatin*
the Air, let 'em ſlip, and give the *Quickſilv*
free leave to *deſcend*.

Sixthly, Since the ſaid Vapours and Exh
lations *retain* their *inviſible Size*, as long as the
are on the *riſing Side* ; the Air muſt hold 'e
in *ſuſpenſe* at their *greateſt Height* for ſom
time ; and after that, let 'em *ſink downwar*
by protracted *Degrees*, till ſeveral Concretio
have conſiderably *alleviated* the Air : ſo th
the *Quickſilver* has opportunity to give
timely notice of the enſuing *Rain*, ſeveral *Ho*
before it happen : And if the ſultry *Heat u*
derneath rarifie 'em again before they approa
the Earth, the *Fall* of the *Quickſilver* may pr
vent it ſeveral *Days*, nay ſometimes *Weeks*
more ; and upon ſuch Repetitions, the *Quic*
ſilver pays conſtant Attendance on ſu
Changes in the *Atmoſphere*, by *Riſing* and *F*
ling alternately all the while.

Seventhly, It is remarkable, that the *A*
which ſuffers the ſaid *Alterations*, being e
tremely *Fluid* ; and the *Atmoſphære*, where
they are ſtirred up, of a *Thickneſs* proportiona
to allow it, upon any Commotion, free Libe

rowl it ſelf again into the *eaſieſt* Poſture :
ence it is, that the *Prognoſticks* of *different*
ather, commonly extend farther than where
e *Change* is actually made ; as when the
eather-glaſs in *Lancaſhire* reſents the Fall of
in in *Yorkſhire* : And ſometimes the Aerial
acuations are vaſtly *extended*, that diſcharge
eir Burthens within a *ſmall* Compaſs, as
ppens in *Spouts* and *Hurricans* ; and ſome-
es quite contrary, as in the Burning of
ndon ; which rais'd the *Quickſilver* both at
is and in *Lancaſhire*, higher than it has been
ſerv'd in either Place ever ſince.

Eighthly, In caſe the Baroſcope *falls lower*
n the Temper of the *Weather* ſeems to re-
re, by my preſent Account it is occaſion'd
the *Wind* ; which *toſſing* the Clouds *to* and
alleviates the *Atmoſphere* by their Agita-
n : Beſides, the Wind *blowing Horizontally*,
ſt needs divert their propenſion *downwards*
own way ; and the *Higher* the Wind riſeth,
Lower the *Quickſilver* falls ; and when the
nd is *quite fall'n*, it muſt return to its *former*
ght : Hence it follows, that it muſt ſtand
heſt in the *longeſt Drought* and *calmeſt* Wea-
r ; and fall *Loweſt* in the Depth of a *Rainy*
Stormy Seaſon, when the common Stock
Vapours and Exhalations is Exhauſted.

Laſtly, Seeing the *Quickſilver* ſtands no
her in *Summer*, when the Weather is *Hotteſt*,
the ſaid Vapours and Exhalations *moſt*
und ; than it does in *Winter*, when the Air
moſt intenſly *Cold* and *Dry* ; and has not
t Maſs of Rainy and Windy Matter to be
in'd, nor the Sun to *ſupport* it : Hence I
ſt needs infer, that the *Atmoſphere*'s *Gravi-*

tation grows more propenſe for want of
reverberated Rays to alleviate it by Reboun
and draws its *Summer's* and *Winter's* Ponder
tion towards an *Equality:* But upon a farth
Conſideration, that tho' it be Compos'd
the *groſſeſt* Air, 'tis throughly *Rarified* by t
Summer's Heat, and alleviated by the *Horizo*
tal Motion of the Wind; and *Condenſed* agai
by the *Winter's Cold*, to its natural *Groſſneſ*
to reſtore it to the proper Exerciſe of its Gr
vitation: Which cannot fail to adjuſt its *Su*
mer's and *Winter's Preſſure* upon the *Baroſco*
to a perfect *Equivalence* at both thoſe Seaſo

So exactly does the *Riſe* of the *Quickſil*
in the *Baroſcope* deſcribe the Weight of
Counterpoiſe of Vapours and Exhalations, rai
in the Air by the Beams of the *Sun*; who
Ponderation *ſinks 'em down* again into *Sprin*
Rain, and *Wind*, with a Dependance upon
endleſs variety of contingent Circumſtanc
within the *temperate Zones:* Whence it occ
to diſcuſs, how, on the Contrary, the Co
duct of the *Sun's Courſe* alone prevails in
Torrid; to fix the ſaid Variety into ſo Ste
faſt and Setled an Influence upon the *Moti*
of the *Wind*, both as to *Force* and *Point*, as
render 'em either *Periodical* or *Perpetual.*

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CHAP. IV.

f the Motion of the WIND*, as depending on the Courſe of the* SUN.

SINCE the Heat of the Sun, both *Raiſeth* and *Supporteth* the Air,inaſmuch as it is the ſubject Matter of the *Wind*; and ſolely diſpoſeth it to *deſcend* again, meerly by the ompoſition of his *lighter* Rays with the *hea-* *er* Air, *puffing* it up *Spherically*, and letting it k alternately by *Condenſation*, when they are *thdrawn*, as it were, to fill up the *Vacuity* t behind 'em: And, in regard the *Sun* at ce both Enlightens and Warms one *Hemiſ-* *ere* of the *Globe*,and turns around it in *Twenty* *ur Hours*; it muſt, *Cæteris paribus*, draw the *nd* after it by the *ſame* Means and the *ſame* ay, in *all* Places *ſucceſſively*, from Pole to le; in compliance with its *Weſterly* Motion. But not at the *ſame* Rate; running a *Thou-* *d Miles* an *Hour* upon the *Equator*, with re- ct to the Earth's Superficies; which, at the *les*, are ſhut up in a *Point*; from whence creaſing his Speed, pariform to the *different* *ngths* of the *intermediate Parallels*; and the *ifter* his Courſe grows, moving the Air l more and more effectually; the *Wind*, ad- ring to his Diurnal Courſe, upon its Ad- nce to about *Thirty Degrees* of either *Lati-*

tude, blows to the *Weſtward* perpetually ; eſpecially *at Sea* ; where no Land-Impediment fall in its Way, either to obſtruct or diver it.

And although, purſuant to his Diurna Courſe from *Eaſt* to *Weſt*, (which is ſo *Swi* and *Direct* between the *Tropicks*) the *Win* moves *conſtantly* towards the ſame Quarter yet ſtill with due regard to his *Annual Declination*, it deflects more *Northerly* or *Southerly*, according to the *different* Seaſons of the *Year* without a Dependance on any other Cauſe inaſmuch as its Blaſts *ſoar aloft* in the Ai where its Flux is moſt *Uniform*, and eaſily inclined to follow thoſe *ſolar Impreſſions* ; but, i regard its *natural Tendence* declines it toward the Center of the Earth, and it falls at la upon the Surface, either of *Sea* or *Land* ; muſt in ſome Meaſure, be *Regulated* by th Conduct of their *Situations* ; eſpecially *Land*, where its Surface is *rough to hinder* i Speed, or *oblique to deflect* its Courſe.

Again, notwithſtanding the *Water's* Superficies be *ſmooth* for the *Wind* to glide eaſi over it ; and of its own Nature *preponderat* the incumbent Air, which is much *light* and conſequently apt to *float* upon it, witho *ruffling* its Plain into any Diſorder ; yet, regard they are both *Liquid Bodies*, to clea cloſe together, and are withal effectually *a ply'd* to each other, by the ſuperincumbe *Atmoſphere* ; the ſuperjected *Wind* and the ſu ſtrate *Sea*, muſt *mutually* ſtir up each othe Motions ; the Former by its *Weight*, and t Latter by its *Volubility*, where it has *room* rowl ; and by conſequence, the *Flux* of t

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Sea muſt ſhare with the Rays of the *Sun*, in their ſway over the *Wind* between the *Tropicks*, and very *Effectually* too; when the *Space of their Coheſion* is of a large Extent; and their joint Motion is *Conſtant* and *Perpetual.*

Hence it is effected, that the *ſame Wind* which was *Firſt* carried *Weſterly*, by the *Diurnal* Courſe of the Sun; and now *Secondly*, is declined, by his *Annual* Motion, more *North* and *South*; *Thirdly*, Is often deflected *more obliquely* by the Inclination of the *Shores*; and *Fourthly*, Is return'd back again *Periodically*, from near the *Oppoſite Points*, by the *Sea's Situation*; which is *finally*, (by the concurrence of its Flux underneath) carried *perpetually* quite *contrary* to the *Diurnal Courſe* of the Sun (which firſt ſet it on Foot,) even upon the *Equator* it ſelf, for *Five Hundred Leagues* together.

Now the Flux of the *Ocean*, ſharing with the Motion of the *Sun*, in his Conduct of *Sea-Winds* in general within the *Tropicks*; and *Both* being alike concern'd in the Management of the *Trade-Wind* in particular; it falls very opportunely to ſhew, what reſpect *that Wind* bears to their *joint Direction* in *ſeveral Seas*, at *what Seaſons*, and on *all Occaſions*; for an eaſy and expedient *Tranſition* from my *paſt* Diſcourſe of the *Courſe* of the *Wind*, to my *enſuing* Treatiſe of the *Motion* of the *Sea*; by a ſuitable Mixture of *Both* in *One*, in this *Chapter*; before I venture upon thoſe which are *Peculiar* to the *Ocean* it ſelf; as that of the *Tide* is, which depends upon quite *different* Cauſes: *Here* I ſhall endeavour to demonſtrate, how much the *Trade-Wind* is beholden to the

Motion of the *Sea*; and *there*, in what reſpect the *Sea's* Motion depends on the *Wind*; producing all along *ſome Inſtances* for that purpoſe, in their proper Places.

S E C T. I.

Of the Motion *of the* Trade-Wind, *and its dependance on the* Courſe of the Sun.

WHEREAS all this while, I have train'd up the *Wind* thro' its *Minority* from its firſt Production, without the *Tropicks*; where it began *low*, and roſe by Degrees, and generally was of a *ſmall Extent*; and conſequently *eaſily deflected* out of its Courſe, by every Bogg and Mole Hill that ſtood in its way; yet afforded *more Matter*, than the Slow and ſcatter'd *Obliquity* of the Sun's Rays were able to manage: Now, on the contrary, in the *Torrid Climate* of the World, where his Motion is *Swifter*, and his Rays *Perpendicular* and more *Compact*; and the Sunburnt *Earth* neither overloads 'em with *Moiſture*, nor any inequality of the *Sea* makes *Reſiſtance* to their Operation; his Conduct of the *Wind* muſt be *Conſtant* and *Univerſal*; tending *Diurnally* into the *West*, and *Annually* towards the *North* and *South*; and its Motion muſt be purſuant thereto, as long as the *obviating Coaſts* and *Shores* will permit the *Air* to move the ſame way, without any *Deflection* or *Impediment* of ſome other Kind.

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To begin with the general *Trade-Wind*, which is moſt *conſtant* for Motion, and of *greateſt* Extent: Dr. *Edmund Halley* demonſtrates, that it neceſſarily depends on the *Diurnal Courſe* of the Sun; in regard the Air, which is *leſs rarified* by his Heat, and conſequently more *Ponderous*, muſt have Motion *towards* thoſe Parts, which are *more Rarified* and *leſs Ponderous* (according to *Staticks*,) to bring it to an *Equilibrium*: Again, the Preſence of the Sun continually ſhifting to the *Weſtward*; that part, to which the Air tends by reaſon of the Rarefaction made by his greateſt *Meridian Heat*, is, with him, carried *Weſtward*; and conſequently, the Tendency of the *whole Body* of the lower Air is that way: Hence is formed a *general Eaſterly Wind*; which being *impreſs'd* upon all the *Air* of a vaſt *Ocean*, the Parts impell one the other; and ſo keep moving, till the next Return of the Sun; whereby ſo much of the Motion as was *loſt* is again *reſtor'd*; and thus the *Eaſterly Wind* is made perpetual.

From the ſame Principles, Dr. *Halley* tells us it follows, that this *Eaſterly Wind* ſhou'd, on the *North Side* of the *Equator*, be to the *Northward* of the *Eaſt*; and, in the *South Latitude*, to the *Southward* thereof; while the Sun is *upon* or *near* the Line: the Air being there *more rarified* and his Motion *ſwifter*, than at any diſtance from it: Which Motions, by his Account, being ſuperadded to the former *Eaſterly* Wind, anſwers all the *Phenomena* of the *general Trade Wind*.

Such is the *Eaſterly* Tendence of the *general Trade Wind*; as alſo its *North* and *South-Eaſterly*

Inclination, on each ſide towards the Line; while the Sun's *Diurnal* Motion keeps near the *Equator*, as Dr. *Halley* has already demonſtrated: But, before I proceed to meddle with its *ſhifting* Motion, as cauſed by the Suns *Annual* Declination towards the *Poles*; 'tis farther requiſite to take along with me his *Hiſtorical Relation* of Matter of Fact, which I ſtrictly obſerve, and is as follows: *Viz.*

In the *Indian Ocean*, the Winds are partly *general*, as in the *Ethiopick Ocean*; partly *Periodical*: That is, *Half the Year* they blow one Way, and the *other Half* near upon the oppoſite Points; and theſe Points and Times of Shifting are *different*, in different parts of the *Ocean*: The *limits* of each Tract of Sea, ſubject to the ſame Change or *Monſoon*, are certainly very hard to determine: But the Diligence [*ſays He*] I have us'd to be rightly inform'd, and the Care I have taken therein, has, in a great Meaſure, ſurmounted that Difficulty; and I am perſuaded, that the *following* Particulars may be rely'd on.

1. That between the *Latitudes* of 10 Degrees and 30 Degrees *South*, between *Madagaſcar* and *Hollandia Nova*, the *general Trade-Wind*, about *South East* and by *East*, is found to blow all the Year long, to all Intents and Purpoſes, after the ſame Manner, as in the ſame *Latitudes* in the *Ethiopick Sea*.

2. That the aforeſaid *South-East Winds* extend to within 2 Degrees of the *Equator*, during the Months of *June*, *July*, *August*, &c to *November*; at which time, between the *South Latitudes* of *Three* and *Ten* Degrees, be

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ing near the Meridian of the *North End* of *Madagaſcar*, and between *Two* and *Twelve South Latitude*, being near *Sumatra* and *Java*, the contrary Winds from the *North Weſt*, or between the *North* and *Weſt*, ſet in and Blow for *half a Year*; *viz.* from the Beginning of *December* till *May*; and this *Monſoon* is obſerv'd as far as the *Molucca Iſles*.

3. That to the *Northward* of *Three* Degrees *South Latitude*, over the whole *Arabian* or *Indian* Sea, and *Gulph of Bengal*, from *Sumatra* to the Coaſt of *Africa*, there is another *Monſoon*, blowing from *October* to *April*, upon the *North-Eaſt* Points: But in the other *Half Year*, from *April* to *October*, upon the oppoſite Points of *South Weſt* and *Weſt South Weſt*, and that with rather more Force than the Other, accompanied with dark Rainy Weather; whereas, the *North-Eaſt* blows clear: 'Tis likewiſe to be Noted, that the Winds are not ſo *conſtant*, either in Strength or Point, in the Gulph of *Bengal*, as they are in the *Indian Sea*, where a *Certain* and *ſteady Gale* ſcarce ever fails: 'Tis alſo remarkable, that the *South Weſt Winds* in thoſe Seas are generally more *Southerly* on the *African* Side, more *Weſterly* on the *Indian*.

4. That, as an Appendix to the laſt deſcrib'd *Monſoon*, there is a Tract of Sea to the *Southward* of the *Equator*, ſubject to the ſame *Changes* of the Winds; *viz.* Near the *African* Coaſt, between it and the Iſland of *Madagaſcar*, or St. *Laurence*, and from thence *Northward* as far as the *Line*; wherein, from *April* to *October*, there is found a conſtant freſh *S. S. W. Wind*; which, as you go more *Northerly*,

becomes ſtill more and more *Weſterly* ; ſo as to fall in with the *W. S. W. Winds*, mention'd before in thoſe *Months* of the Year, to be *certain* to the *Northward* of the *Equator*.

5. What *Winds* blow in theſe Seas for the other *Half Year*, from *October* to *April*, [*He*] had not yet been able to obtain to his full Satisfaction ; for that our *Navigators* always return from *India* without *Madagaſcar*, and ſo are little acquainted in this Matter : The Account that has been given [*Him*] is only this; that the *Winds* are more *Eaſterly* hereabouts; and as often to the *North* of the true *Eaſt*, as to the *Southward* thereof.

SECT. II.

Of the Shifting Trade-Winds ; *and their dependance on the Sun's* Zodiacal Declination, *with regard to the* Equinoctial *Poſition of the* Arabian Sea.

SO ſtrictly does the mutual Concourſe of the *North* and *South-Eaſterly* Trade-Winds obſerve the *Equator*, while the Sun's *Diurnal* Motion keeps cloſe to that Line : But, when his *Annual* Declination withdraws his *vertical* Rays, and the Air grows cooler in his Abſence ; the joint *Occurſe* of the ſaid Winds (as following cloſe to his *greateſt Meridional Heat*,) muſt alſo *decline* with him into the ſame *Latitude* ; whether it be to the *North* or *South* : And thoſe Winds muſt make their *half Yearly*

Returns of *Summer* and *Winter* alternately, on each ſide of the *Equator.*

Beſides, the ſaid Space of rarefied Air, ſtill attending the Sun's *Zodiacal Declination* ſucceſſively towards each of the *Tropicks*; and ſtill intermediating between the ſaid *North* and *South-Eaſterly Winds,* muſt needs *ſtagnate* into Calm of ſo conſiderable a Breadth, on each ſide of that *ſhifting Line* deſcrib'd by the *Sun's Declination,* as to hinder the ſaid *oppoſite Fluxes of Air* from approaching each other at their Congreſs; that Geographers commonly aſſign a Tract of *twelve Degrees* Tranquility: So that the Sun's *Tropical Declination* (being extended at leaſt *twenty-three Degrees,*) more than doubly ſufficeth, to *draw* the ſaid *Vacuity* from one ſide of the Line to the other, with an *Half-Yearly* Viciſſitude; as is Manifeſt.

Now, the *Poſition* of the *Arabian Gulph,* or that part of the *Indian* Sea which the ſaid *ſhifting North* and *South-Eaſterly* Winds chiefly affect, being *Equinoctial*; it concurs very opportunely with the *Zodiacal* Motion of the Sun, either to remove 'em Alternately out of that Compaſs, as not exceeding *ten* Degrees on the *South* of the *Equator,* and *twelve* Degrees to the *Northward* of that Line; or at leaſt, to *abate* their Force in ſuch meaſure, as not to be able to reſiſt the *South,* and *North-weſterly Monſoons*; which of courſe *ſucceed* 'em from the Oppoſite Points every *Half-Year*, at their reſpective Seaſons, to ſupply the *Vacuities* left behind them.

Hence it comes to paſs, that the *North* and *South-Eaſt* Trade-Winds, never blow Both *at once* within the Compaſs of the Gulph or Sea

aforeſaid; the *One* being no ſooner *drawn*
by the Sun's Declination, than the *Other*
brought on again by its own Weight, to fill
the *Vacuity*, left on the other Side of the *Equ*
tor: For ſo it happens in *April*, when the Su
having paſs'd the Line into the *Northern Sign*
at once carries off the *North-Eaſt* Trade-Win
from it, and draws Thither the *South-Ea*
Wind after it; and having repaſs'd it again t
the *Southward*, brings thoſe Winds back again
and ſo carries 'em *Backward* and *Forward*; th
One towards the Line, and the Other froward
it, by an *Half-Yearly* Viciſſitude for ever.

It is farther obſervable, that thoſe *Eaſte*
Trade-Winds, and *Weſterly* Monſoons, whic
happen at the *ſame* Time, blow jointly eith
towards the *North* or *South*: As from *April*
October Both blow to the *Norward*, purſua
to the Sun's Declination into the *North-Sign*
drawing 'em Thitherward, from a more Den
and Ponderous *Winterly* Seaſon, into a mo
expanded and rarefied Air of *Summer*; an
on the contrary, They jointly, from *Octo*
to *April*, attend in the *South* on his Preſenc
upon the ſame Occaſion; ſo that the *Weſte*
Monſoons, inaſmuch as they blow *North*
South, are as effectually Influenced by the *A*
nual Courſe of the Sun, as the *Eaſterly Tra*
Winds are to blow Hither or Thither at t
ſame Seaſon.

Hence it comes again to paſs, that the ſ
South-Eaſterly Winds, as Dr. *Halley* obſerves, e
tend from the aforeſaid *Ten Degrees South-L*
tude, near the *Equator*, during the Months
June, *July*, &c. to *November*; while the S
remains to the *Norward* of the *Line* to dr

Thitherwards : And, on the contrary,
t there is blowing a *North-Eaſterly* Wind for
other Half-Year from *November* to *June*,
Sun being on that Side of the *Line* to at-
ct it. Now *Why*, or *How* thoſe Two *Ea-*
ly-Winds, ſo intermixing, ſhou'd each be
ply'd for its reſpective *Half-Year* by a *We-*
y-Monſoon from the Oppoſite Point ; and to
gn a Cauſe able to produce ſo *conſtant* an
fect, leaves no *Phenomena* of the *ſhifting*
de-Winds Unaccounted for.

SECT. III.

w the South *and* North-weſtern Monſoons,
re reſpectively Regulated by the Situation *and*
Figure of the Arabian-Sea.

HAVING ſhewn already (in the *Former*
of the Two precedent Sections,) that
South-Eaſterly Wind, which blows perpe-
lly from *Thirty* to *Ten* Degrees of the *ſame*
titude, is drawn *Eight* Degrees nearer the
ne, on the *Eaſt* Side of the *Arabian-Bay*,
m *November* till *April*, by the Sun's *Declina-*
to the Norward : And in the *Latter*, that
South-Weſt Monſoon, by virtue of his ſaid
clination, blows to the *Norward* at the ſame
ne : Let us ſee how it acquires a *Weſterly*
rn, by the Conduct of the ſaid *Bay*'s *Situa-*
on that Side. And it is Obſervable,

Firſt, That the *African* Shores, which coa the *Ocean* towards the *Weſt*, tend *North-Eaſte* from the *Cape of Good Hope* all along to th *Equator*, and beyond it to the Bottom of th ſaid *Bay*; the Land being *High* for the mo part. And Sea-Winds, being a *heavy* Meteo muſt conſequently as ſtrictly obſerve *their D rection*, as Rivers do the Banks which *bou* 'em; and the Winds *muſt follow* their Condu as far as they reach, eſpecially at that Seaſo when a ponderous Load of *Winterly Air*, an Foul Weather, *drives* 'em Thitherward; wi more vehemency, as Dr. *Halley* takes notic than *any other* Winds that Trade in tho Seas.

Beſides, the ſaid *South Ocean*, whoſe Supe ficies ſuſtains that *South-Weſt* Wind all t while, ſending its Tide *directly Norward* t wards the ſaid *Bay*, being alike contracted o That Side by the *Inclining Shore*, the Flux of *Coaſting Current* muſt be proportionably *haſten* and conſequently communicate to the *ſuper cumbent South-Weſterly Monſoon*, a more fix'd a ſteady Determination, and drive its Flux *deep into the Bay* as it went before.

In conſequence whereto it is Obſerv'd, th a conſtant Current of the Sea, for all th Tract from *Madagaſcar* to the *Equator*, entri the *South-Weſt* Corner of the *Indian Oce* (where the *Monſoons* firſt begin to ſhift) ca ries the ſuperincumbent Air along with down into the *Arabian Gulph*: And, as D *Halley* affirms, a conſtant freſh *South-Weſte* Wind blowing along that Coaſt, on both Si the Line; which, the farther you go *Northe*

ill blowing more *Weſterly*, falls in (*ſays He*)
h the *South-Weſterly Monſoon*; or rather, gives
a beginning by falling in with it in *April*,
d ending with it in *October*: which plainly
monſtrates, that They *compoſe* and become,
it were, the *ſame* undiſcontinued Flood of
ater and Wind, conjoin'd, without any di-
nction; while the Sun's *Norward Declination*,
once encourages the *South-Weſt* Wind to
w, and withdraws that *North-Eaſterly* Wind,
ich otherwiſe would Oppoſe it.

Hence it comes to paſs, that the *South-Weſt*
nſoon, as being deriv'd from the joint Cur-
t of Wind and Water aforeſaid; following
South-Weſterly Direction of the *African*
re, which ſtill contracts and enforceth it
h by Land and Sea; and having paſs'd the
uator, its proper Limit, penetrates to the
tom of the *Arabian Bay*: Whereas, the
h-Eaſt Trade-Wind, which blows at the ſame
ne, on the *South* Side of the Line, never
cheth it, for want of the like Aſſiſtance
m any *Shore* or *Current*, to help it forward:
, on the contrary, falls ſhort of its Natu-
Courſe, at leaſt *two* or *three* Degrees, as
ng repuls'd by the *contrary Motion* of Sea and
nd; as will appear.

Now to derive the *North-Weſt Monſoon* regu-
y from the ſame Source, or Current of
ter, only *reflex'd*, which brought the other
nſoon directly from the *South-Weſt*; it is to
Noted, that the *Bay*, wherein they are Both
pagated, is of a *Triangular Figure*; the Sub-
ſe of whoſe *North Angle*, pointing directly
t and *West*, ſeparates the ſaid Bay, on the

South, from the wide Ocean, with a Bar
compos'd of *Iſles* and *Shallows* ; whereon
ſaid *South-Weſterly* Current falling *obliqu*
and entring into the Gulph at its *South-W*
Angle, is reflected from near the *Center* the
of, towards the other End of the ſaid Barri
where the Stream refunds it again, by an
ſterly Outward-bound Paſſage, into the Oce
whence it came ; drawing the incumb
North-Weſt Monſoon after it from *October* to *Ap*
its proper Seaſon.

Conformably to the Scheme of the *So*
Weſterly Flux, and *North-Weſterly Reflux* of
ſaid Current ; Dr. *Halley* aſſures us that a fr
Weſterly Wind attends it down the Bay ; whi
the farther you go *Northerly* ſtill blows mo
Weſterly, till they Both approach near the
ſtern Shore ; where the Current (being no
on its Return towards the Ocean) *veres* abo
to the *Norward*, and thence *Weſterly*, till it fa
in with the Conduct of the oppoſite *Eaſt*
Coaſt ; and follows its Direction as far as t
Maldiva Iſlands ; which, tending Lineally
the *ſame* Point, ſteers on its Courſe forwa
ten Degrees farther, till it reach the *Equator.*

Now, in regard as the ſaid Current, d
ſcending into the *Bay*, goes on diſperſing
Stream into almoſt Calm Water ; ſo the opp
ſite *Eaſtern* Shore recollects it again, and r
vives its Motion by the like Degrees, till
have paſs'd the ſaid *Iſlands* up to the Lin
where it falls in exactly with the Tendence
the *North-Weſt Monſoon* : Hence it muſt nee
ſtir up *There* a Motion in the incumbent A
of *That* Tendence ; the oppoſite *South-Ea*
Trade-Wind being already withdrawn by t

Su

's *Declination*; and muſt carry that *Monſoon*, rais'd, along with it, according to the *ſame ection*, *ten* Degrees farther, being its proper mit, till it meet with the ſaid Wind to ſtop and the Stream underneath, having paſs'd r the aforeſaid Barrier of *Iſles* and *Shoals*, be unded into the Ocean whence it came.

Thus *both* the *Weſterly Monſoons* are equally holden to the ſame Current: That from the *thward*, as being carried down the *Arabian-* towards the *North-Eaſt*, by its *direct* Courſe; d This from the *Norward*, as return'd back in by its *Reflux* into the *South-Eaſt*, in com- ance with the Streams underneath; yet h This Difference, that whereas the Courſe the Water, meeting no oppoſite Stream to pute its Paſſage, is *perpetual*: On the con- ry, the concomitant Fluxes of the *Weſterly nſoons*, upon the Occourſe of the oppoſing *de-Winds*, alternately deſiſt, and become *iodical*: Thoſe *Eaſterly-Winds* within their mpaſs, over-powering all Oppoſition, ſo either to reſtrain the ſaid contrary *Monſoons*, ſet 'em at liberty; while the Sun's *South North Declination*, by *half-Yearly* Returns, al- nately ſets on the ſaid *Eaſterly* Winds, or kes 'em off again.

Hence it is, that the ſaid *South-Weſt Mon- ns* begins to blow in *April*, when the Sun's ntrance into *North* Signs withdraws the op- ſite *North-Eaſt Trade-Wind*, which diſconti- nes till *October*; when the Sun, by repaſſing e Line into *South Latitude*, brings it on again: alſo the *North-Weſt Monſoon* blows the other *lf-Year* from *October* till *April*, and then de- ts; with regard to the *South-Eaſt Trade-Wind*, which riſeth to countermand it : Juſt as *Land-Breez* which, following the Streams of freſh River be naturally *Perpetual* ; nevertheleſs they a driven back *Periodically*, by the Salt-*Floods* ti their *Ebbs* give 'em leave to return again, an blow *Sea-ward* as they did before.

Again, from *October* to *April*, notwithſtand ing the *North-Eaſt Trade-Wind* has driven bac the oppoſite *South-Weſt Monſoon*, from its Adheſion to the *direct* Courſe of the *South-W* *Current*, which produc'd it ; yet its Strea being *reflex'd*, and ſtill retaining its form Force and Speed, muſt gradually decline th Motion of the Incumbent Air from the *Ea* *ward* to the *Weſtward* of the *North* all th while ; till it has repaſſed the *Line* to the *Sout* *ward*, and effectually rais'd the *North-Weſter* *Monſoon* ; having eſcaped out of the Compa of the *North-Eaſt* Wind, which would ha *deflected* its Courſe ; the *South-Eaſt* Wind bein alſo withdrawn by the Sun's *Southerly Declin* *tion*, which otherwiſe wou'd have oppos'd an baffl'd it into a Calm.

Hence I conclude, That thoſe *North* an *South-Eaſterly* Winds which follow the *Diurn* Courſe of the Sun, never blow on *both* Sid of the *Equator* at once ; and that that *Curr* of the Sea, to which I aſcribe the contrar *South and North-Weſterly Monſoons*, ſerves onl *When* and *Where* thoſe *Eaſterly* Winds intermi to *determine* the Motion of the Air that wa to ſupply their reſpective *Vacuities* till the Return : And that thoſe *Two ſhifting* Win which blow at once, tend jointly either *North* or *South* ; and ſtill towards the Sun that the Inequality of their *Summer's* Levi nd *Winter*'s Gravity, may give Force and Celerity to their Motion, ſo as, in Subſtance, o be the *ſame North* and *South* Winds, but nly *differently determin'd* on each Side of the *quator*; *Eaſterly* by the Sun's *Diurnal* Rendence; nd *Weſterly* by the *Current* aforeſaid.

SECT. IV.

ow the ſaid ſhifting *Winds are propagated in the Gulph of* Bengal, *and Sea of* China.

NOW, for as much as the Gulph of *Bengal*, and Sea of *China* are *alike* affected y the ſaid *Weſtern Monſoon*, and at the *ſame* ime; and all Three lye *collaterally* to each her, and *lineally* to the ſame Ocean, which oduc'd the aforeſaid *Current*; the *Tidal* Tuour thereof, to render the Cauſe *coextenſive* ith its Effect, muſt ſpread it ſelf *comprehenvely* over 'em All at once, to produce ſo *general* d Uniform a Commotion in the Air. And that *Monſoon* be not ſo conſtant, in Strength, Point, in the *Gulph* of *Bengal*, as it is in the *abian Bay*, 'tis becauſe the Ocean, being *ntracted* all along the *African* Shore, more *mediately*, and conſequently more *ſharply*, fects it; and ſo muſt needs give the Wind a ore fix'd and ſteady Determination *there*, than ter it is *dilated* by a greater Expanſion.

Beſide, the ſaid Gulph being alike of a *iangular* Figure, as well as the *Arabian* Bay; d They lying reſpectively in the ſame *Hori-*

zontal Poſition ; the *Tidal* Motion of the Se
which, jointly with the aforeſaid Curren
falls into 'em Both with the ſame *Obliquit*
muſt equally affect 'em *directly* with a *Sout*
Weſterly Monſoon, and *Reflexedly* with a *Nort*
Weſterly One : And Both lying conjoyn'd an
open towards the *South*, and *alike ſubtended* b
the Barrier aforeſaid, on that Side ; the *Nort*
Weſt Monſoon, as being jointly directed by 'e
Both, muſt reach coextenſively along with i
from the *Eaſtward* of *Madagaſcar* to *Sumatr*
as is found by Obſervation.

But as to the *Chineſe* Sea, altho' it lies on th
ſame Side of the *Line*, and according to th
ſame *South-Weſt* Direction, with open Mou
towards the *Indian* Ocean, to partake of th
ſaid *South-Weſt* Monſoon ; yet its Chann
more reſpecting the *North* and *South* Poi
than the Bays aforeſaid do ; its *Flux* of A
as well as of Water, muſt needs deflect t
ſame way : But, it being withal an *Obl*
Tract of Water, and not *Triangular* ; beſi
being a *Thorow-fare* Paſſage out of one S
into another, it can by no means *reflect*
Stream, either of Air or Water, back towa
the *South-Eaſt* in favour of a *North-Weſt M*
ſoon ; which is neither found in this Sea,
can be reaſonably expected in any other,
different Poſition or *Figure* from the Bay
Gulph aforeſaid.

Now, from what I have already ſaid of
Matter, it appears 1. That the Place ſo affe
with the *Monſoons* muſt lye upon the *Equ*
or near it, to *ſhift* 'em with the Sun's Decl
tion, both *Northward* and *Southward*, accord

the different *Seaſons* of the Year : Hence all as, of any *other Poſition*, are incapable of e like Alteration.

Beſides, the *Figure* of that Part of the *Indi-* Ocean which is ſo affected, muſt be *Trian-* *lar* ; with an *Inlet* at its *South-Weſt* Angle to ceive the Stream of Water which conducts e *South-Weſt Monſoon* into the Bay ; and an *tlett* at its *South-Eaſt* Corner, to ſet the *rth-Weſt Monſoon* off again by the *oppoſite* int ; as appears by the ſpecial Service of *ry Part* of the ſaid Bay ; and how proper s to perform its Office.

It was farther requiſite, that a *Barrier*, conſiſt- g of *Iſles* and *Shoals*, ſhou'd paſs between the *th-Weſt* and *South-Eaſt* Paſſages, to ſtreng- n the aforeſaid Current (which almoſt *gnates* in the Middle of the Gulph) into a eam, to ſtir up the Incumbent Air into a *th-Weſt Monſoon* ; and withal, it was to be a proportionable Breadth, to continue its x over that Rampire for *Six Degrees* together, o the *Southerly* Ocean, to meet the *South-Eaſt* *de Wind*, which was to ſtop it before it ſ'd.

And this *Barrier* was to be but of a *Mean* ure ; neither ſo *High* as to hinder the Tide n paſſing over it ; inaſmuch as it might be ourable to both the *South* and *North-Weſt* *nſoons* ; by letting the One *enter* the Bay as ly at the *Weſt* End of it, as the other to ff at the *Eaſt* ; nor yet ſo *low* as to admit Floods in ſo full a manner, as to controul bſtruct their ſhifting Motion.

Moreover, the *South-Weſtern Current* of Wind, ich Coaſteth the *African* Shore, from near

the Iſle of *Madagaſcar* to the *Equator* ; T
which Dr. *Halley* allows a Periodical Flux fro
April to *October* ; yet terms it, not improperl
only *An Appendix* of the *South-Weſt Monſoon*, t
it hath paſs'd the Line, tho' it be the *Orig*
and ſole *Cauſe* thereof ; in regard, till it ha
paſs'd the *Equator*, it remains out of the Su
Power to give it Check, and Return it when
it came by his *Southerly* Declination : Eſpe
ally, the concomitant *South-Weſt Current* of t
Sea, perpetually *reſiſting* its Trading back ag
by the ſame Road for the other Half-Ye
to wit, from *October* to *April* ; or at leaſt w
any *Periodical Conſtancy* or certainty of Moti

SECT. V.

Concerning thoſe Winds, which are Adverſe t
general Eaſterly *Winds, and are* Perpetual

TO omit Thoſe that blow *all the*
without any conſiderable Variat
unleſs what is ſubject to be deflected th
from ſome few Points of the Compaſs, tow
the *North* or *South*, according to the *Poſiti*
the Place ; as being, in all Reſpects, wel
counted for by Dr. *Halley* already ; I ſhall
of courſe take farther notice of Thoſe, w
He propoſeth for *Exceptions* to that ge
Rule ; in order to reconcile 'em to the C
mon Laws of Motion.

1. That to the *Norward* of the Line, bet
Four and *Ten Degrees* of Latitude, and bet

Meridians of *Cape Verde*, and the *Eaſtermoſt*
ds that bear that Name, Dr. *Halley* tells us,
e is a Tract of Sea, wherein it were im-
per to ſay there is any *Trade-Wind*, or yet
iable; —the little Winds that are, be only
e ſudden uncertain Guſts of very little
ntinuance, and leſs Extent; — which He
gns to the *Station* which that Tract holds
ween Two contrary Winds; the One on
North-ſide, blowing *Eaſterly* from the ſaid
pe towards *Guiana* in *America*; and the other
the *South*, from *Braſile* towards *Guinea* in
ica; which were more proper to turn the
erjacent Air into a *Whirlwind* than to hold
ſteady; Did not that part of the Ocean,
ere the *Atlantick* and *Ethiopick* Floods meet,
ncur to keep it fix'd, as being obnoxious
ither to *Flux* nor *Reflux* to diſturb its Quiet.

2. That in the Tract of Sea, which (on
e *South*) lies next adjoining to *this*, the
therly and *South-Weſt* Winds are *perpetual*;
z. all along the Coaſt of *Guinea* for above
ve Hundred Leagues together, from *Sierra Lio-*
to the Iſle of St. *Thomas*: For the *South-*
ſt Trade-Wind, upon its Entrance into the
reight, (in compliance with the *South-Weſterly*
endence of the Sea-Current along the *Braſi-*
n Shore,) becomes *South South-Eaſt*, and by
grees full *South*: And, being carried down
ith the Stream towards the *Guinean* Shore,
res about to *South South-Weſt*, and by degrees
South-Weſt and *Weſt South-Weſt*, under the
oſe Conduct both of that Stream and Coaſt;
ll at laſt the Current of Water, being repuls'd
y the *Eaſtern* Shore of *Guinea*, returns towards
e *South* (whence it came) to make Reſtitu-

tion : And, being ingulph'd by the *Tide's* tumeſcency, is carried off by *Libration* thith and deflects the ſuperincumbent *Current* Air into the *South* after all, to compleat *Circulation*, as will be farther declared he after.

To theſe which Dr. *Halley* alledges, may ſubjoin'd, as remarkable *Inſtances* of the ſa Truth,

1. That all along the *Weſtern* Coaſt of P for above *Fifteen Hundred* Leagues togeth from near the *Magellanick* Streight as far as Gulph of *Panama*, an uninterrupted and moſt perpetual *Flux* of Air attends the C *rent* of Water which ſupports it ; blowi from *South* to *North* ; or within a Point or to the *Weſtward*, according to the differ *Inclination* of the Shore : notwithſtanding th Exhalations which compoſe it fall down fr the *Andes* out of the *Eaſt* ; and the *Weſtern* *cifick* Ocean lies wide open to receive 'em ; without giving even a beginning to an *Eaſt* *Trade-Wind*, for all that length of Shore (*Fifty* Leagues off at Sea,) which is perc tible.

2. That a perpetual Flux of Air or Wi adheres to the *Coaſting Current* of the *Afri* Shore on the *Ethiopick* Side, from the *Cape* *Good Hope* to near the moſt *Southerly* Part *Guinea* ; which is conſtantly determin'd to bl *Southerly*, by the *Draught* of the Stream und neath ; and withal, the Wind keeps that F of Water on foot, by its conſtant *deſcent* fr the adjacent Shore, ſo as Both to tend thith ward all the while, by the mutual aſſiſtan

each other; with many *Inſtances* of the
me kind, which will be produc'd more con-
niently hereafter, where I profeſſedly treat
the *Motion* of the *Sea*; and ſhew, that the
reſaid *Coaſting Currents* of the Ocean pro-
ed from the *Tide*.

Such is the *Adheſion* of the Incumbent *Air*,
the ſubſtrate *Water*, when they are got into
otion, and have free liberty to follow the
me *Direction*; for otherwiſe *each* may be put
a *ſtop* apart, or *both* be *deflected* ſeveral ways
once; as the *South-Weſt Monſoon*, which we
oke of before, while the *South-Eaſt* Wind
s withdrawn, paſs'd along the Coaſt of
rick down into the *Arabian* Gulph, jointly
th the Stream that conducted it: And, even
er the Current had *ſtagnated* in the middle
the Bay, as ſoon as it reviv'd its Motion
wards the *South-Eaſt*, ſtill purſu'd its *reflex'd*
rection: Yet, no ſooner had the *South-*
ſterly Wind put a Stop to its Career, and the
urrent, *reflected* towards the *North-Weſt*, began
revive and gather Strength, but the *North-*
eſt Monſoon did ſo too, and fell in with it;
d attended it thro' the *South-Eaſterly* Paſſage
to the wide *Ocean*, where both ceas'd toge-
er.

By this Means, theſe *Sea-faring* Winds take
e liberty to diſorder thoſe which Trade out
the *Eaſt*, by the Influence of the Sun; in
me Seas ſtirring 'em up too ſoon, and *acce-*
rating 'em above their uſual ſpeed, as near
pe Verde: Or *contracting* 'em ſome Degrees
ithin their common Limit; and by and by
larging 'em as far beyond it; as all along the

Guianeau Coaſt : In others *thwarting* 'em a much by their *tranſverſe* Courſe from *South* to *North* ; as on the *Weſtern* Shores of *Angola* and *Peru*, for a *Thouſand* Leagues together : In others, blowing directly from the *Oppoſit* Points, as along the *Southermoſt* Part of *Guinea* from *Sierra Liona* to the Bottom of the *Bay* and all this perpetually.

Yet in the *Indian* Ocean,theſe *Sea-bred* Gales become of ſo *complying* a Temper, as to yield readily to the *Periodical* Inſults of its *Eaſterly* *Trade-Winds* ; and withal, as reſpectively to ſupply all the Vacancies left behind 'em in their Abſence ; which anſwers the utmoſt Enquiry yet made into the *Phenomina* of *Winds* and ſhuts up this *laſt* of my *Three* Preliminary Diſcourſes,to the finding out of the Immediate Cauſes of the various and irregular *Motion* o the *Sea* it ſelf, which occaſions 'em.

Concluſion.

TO ſum up, in ſhort, this *Tripartite* Diſcourſe at once, in order to introduce th *next* of the *Motion* of the *Sea*.

Firſt, *Springs*, as conſiſting of *Water*, whic is *Fluid*, to pierce the Surface of the Earth and *Heavy* to ſink it into its Veins, muſt Originally deſcend from the *Sky* ; and as it fal in Drops innumerable, ſo it penetrates it by a many Holes, which, being united underneat muſt gather into *Rills*, and convey'd farthe ſtill ſwell into *Streams* of a larger ſize, till the break forth into the open Air, either on the

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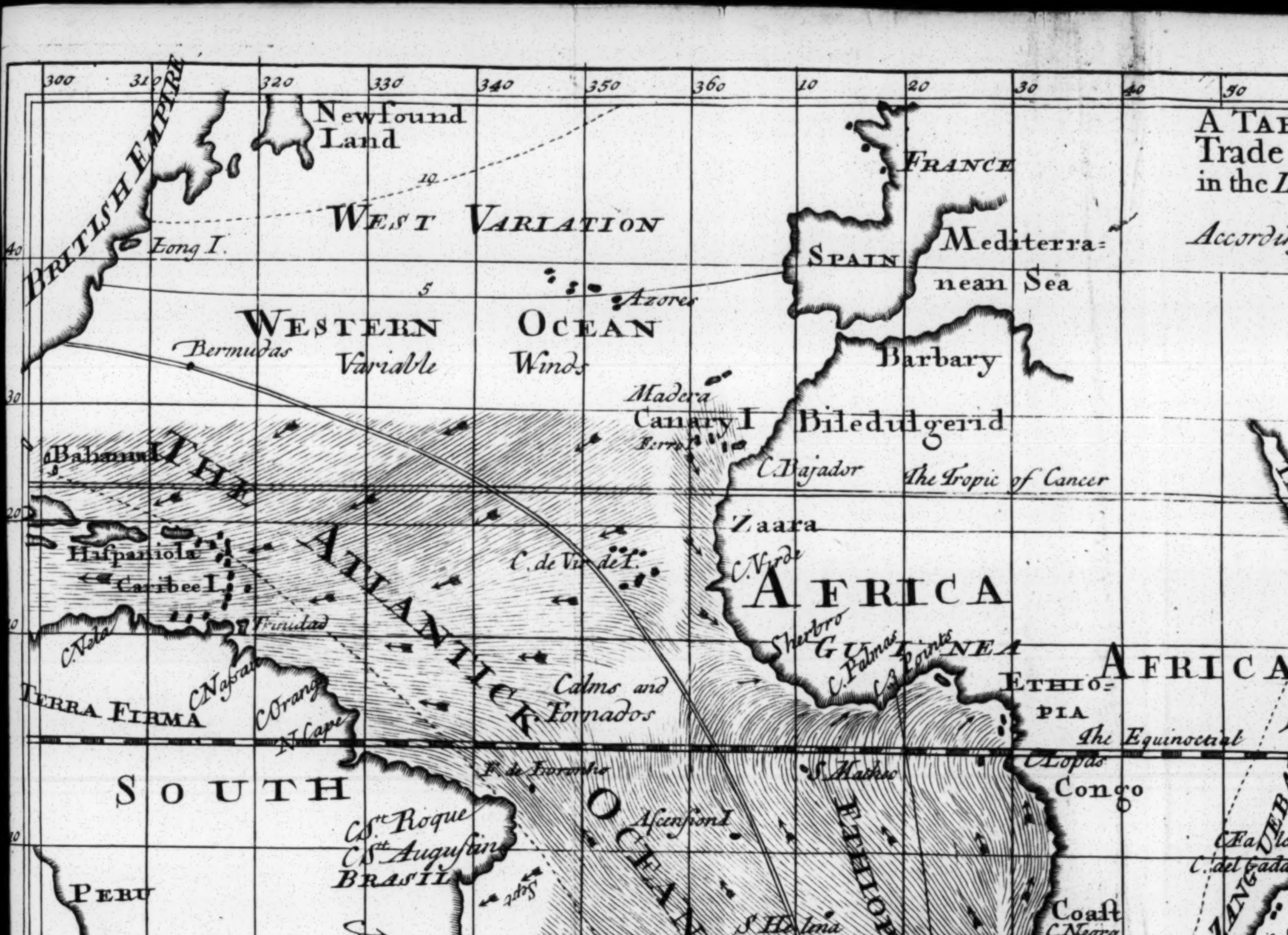
A TA
Trade
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Accordi
BRITISH EMPIRE
Newfound Land
Long I.
WEST VARIATION
WESTERN OCEAN
Variable Winds
Bermudas
Azores
FRANCE
SPAIN
Mediterranean Sea
Barbary
Biledulgerid
Madera
Canary I
Ferro
C. Bajador
The Tropic of Cancer
Bahama I.
Hispaniola
Caribbee I.
Trinidad
C. Vela
THE ATLANTICK OCEAN
C. de Verde I.
Zaara
C. Verde
AFRICA
Sherbro
GUINEA
C. Palmas
C. 3 Points
ETHIOPIA
AFRICA
Calms and Tornados
TERRA FIRMA
C. Nassau
C. Orange
N. Cape
The Equinoctial
F. de Noronho
S. Matheo
C. Lopas
Congo
SOUTH AMERICA
PERU
C. St. Roque
C. St. Augustine
BRASIL
Ascension I.
ETHIOPIAN SEA
S. Helena
Coast
C. Negro
C. Frio
Trinidada
Sept
April
C. S. Sebastian
C. Corventes
Cafers
Ter. de Natal
ZANGUEBAR
C. del Gada
LA PLATA
R. de la Plata
Variable Winds
The first Meridian from Ferro
The Line of no Variation
C. of Good Hope
WEST VARIATION
Tristan da Cunha
EAST VARIATION
SOUTHERN OCEAN
Degrees of Variation
300
310
320
330
340
350
360
10
20
30
40
50
20
25
25
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15
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5
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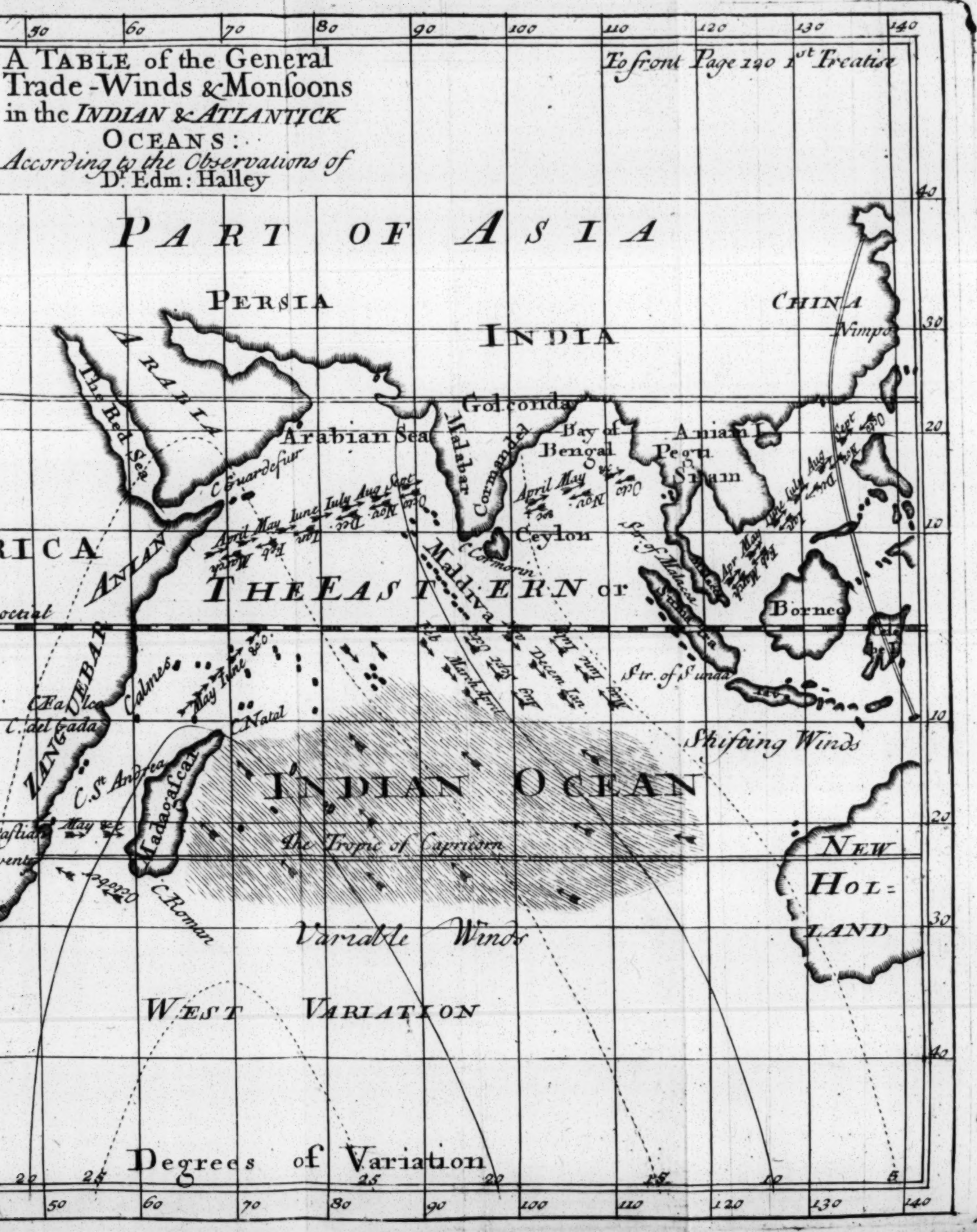
To front Page 120 1st Treatise



A TABLE of the General Trade-Winds & Monsoons in the *INDIAN & ATLANTICK* OCEANS: *According to the Observations of* Dr. Edm: Halley

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own Accord, or let off by the Miner, without any *farther* Supply, than *Rain*; or other *Diverſification* than their different *Deſcents* afford; ſo vain it is, to enquire after *more* Recruits or Managers of 'em, unleſs to puzzle and *perplex* Thoſe, who otherwiſe (if put at firſt into the right Road of Knowledge) wou'd daily improve their Thoughts, for the good of the Publick.

Secondly, It as plainly appears that *Rain* is extracted, in inviſible *Atoms*, indifferently from *Sea* and *Land*, by the Rays of the Sun; which *incorporate* in their Fall thro' the Air, and are caſt, as it were, in *Moulds* of a larger Size, into *greater Drops* of another Species upon every New Concretion; and theſe are again congeal'd by the *Summer*'s or *Winter*'s Colds into *Hail* or *Snow* of as many Sorts: But to ſtir up thoſe *Atoms* of Water into *Storms* they muſt be rais'd to a greater *Height*: And to furniſh a Quantity of 'em into *Tempeſts*; their Extent being *large*, and their Expanſion *evenly ſpread* over the Firmament, and continued for *longer* Seaſon; till the Air become unable to *ſuſtain* 'em, either ſhuffl'd together or in any other Poſture.

Laſtly, To convert Air into *Wind* it ſufficeth to raiſe the *groſſeſt* Part of it uppermoſt; and when the Sun's Heat can *advance* it no higher, or *ſuſtain* it longer, to let it *fall* again by its Preponderation; only more or leſs *obliquely* from the *Perpendicular*, as the Medium *Air* will allow, and the Stock 'tis furniſh'd with requires: And towards that Point of the *Horizon*, that either the Courſe of the *Sun*, or the Declivity of the *Earth*, or the Motion of the *Sea*, whereon it falls, ſhall farther appoint Or, in caſe of their *Indifferency*, the Poiſe o its own Weight *preſſing* downwards, and th *reſiſtance* of the Air, growing ſtill more *obſtinat* by Oppreſſion, makes it wheel about *circularly* for the eaſieſt Deſcent into *Whirlwinds* or *Hurricans*; from the *Weight* of the Matter, and the *Height* of its Fall; as is maniſeſt.

THE

Second Treatiſe.

OF THE

TIDE;

OR THE

Ebbing *and* Flowing

OF THE

SEA;

WHEREIN,

All its various Appearances are Clear'd, and Difficulties Solv'd.

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THE PREFACE.

H*Aving already adjuſted, and ſettled the Preliminaries of* Springs, Rain, *and* Wind; *as to their* Origin, Generation, *and* Production; *I am now to treat of the Motion of the Sea in* General, *before I can branch it into* Particulars, *in ſearch after the immediate Cauſes of the* Tide: *And not to embroil the Matter in Hand with unneceſſary Diſputes, a* Method *is to be propos'd and follow'd; and that which I have actually pitch'd on, being either not* uſual, *or purſued* farther *than ordinary, I ſhall here unfold it before I begin; and at every Step, annex Reaſons for my proceeding after ſuch manner; that the Reader may never loſe himſelf in following it, or be out of his Way.*

Firſt, *In regard the Sea is ſubject to* another *ſort of Motion, I ſhew, (for Diſtinction's ſake) that, whereas that* other *tends always* Weſtward; *this, of the* Tide, *Flows and Ebbs reciprocally* North *and* South; *that is* continual; *this* Periodical, *that depends on the* Trade-wind, *this on the Courſe of the* Sun, *and* Moon; *and that having been diſcours'd on already, (when we treated the* Monſoons*) as to the variety of its Declination towards* North *and* South, *becoming of a quicker Diſpatch, I firſt remove it out of the way; that,* *when it chanceth to interfere in our following* Di *courſe, with the Motion of the* Tide, *it may be e ſily diſtinguiſh'd from it, in ſome of thoſe Reſpe to prevent Confuſion.*

Secondly, *Whereas the* Tide *is liable to ma Diſorders, occaſion'd by the irregular Situation* Coaſts, *and* Shores: *To prevent the framing of wrong Notion thereof, on that Account, I abſta from all ſuch* Reſtraint *throughout my* Fi Chapter; *by ſuppoſing our Globe to be ſurfa around with Water, without End, or Limit; give free Liberty for the* Moon, *to raiſe Two O poſite Tides* daily, *with One Revolution; and t* Sun, *to increaſe 'em twice* monthly; *and b jointly, to raiſe 'em higher than ordinary, as ma times every* Year.

Thirdly, *Since the Univerſal* Ocean *is actua divided into* Three *Parts; and theſe are ſeparat by great Tracts of Land; and the* Indian, *a* Pacifick *Oceans, are leſs known to Us, than Ou which conſiſts of the* Atlantick *and* Ethiopi *Seas conjoin'd, and reacheth the* Artick *and* Anta tick *Circles; to allow the Tidal Flood its full Ra either way, from the* Equator, *whence it is rais Hereupon, I undertake to ſpeak profeſſedly of the Ph nomena of the Tide in* this *Ocean, and only by t* By *of* thoſe *which belong to the other Two: Aga as to the* Diffuſion *of its Flood on each ſide of t* Line, *I chiefly endeavour to analyſe that Part of which transfuſeth it ſelf over our* North Atlanti *Diviſion, with the greater variety of Appearanc and lies more immediately under our Inſpection.*

Fourthly, *After the Arrival of the Tide the* European *Coaſts; and it has enter'd our* Iri *and* Britiſh *Channels; I trace it around both* Iſland *and purſue it to every* Port, *and follow it up*

Rive

Rivers, *as far as they are Navigable*; *denoting all*
g the Time, *and* Place *of their Floods, with*
h Diverſity of their Phenomena, as ſeems to
ridge all kind of Appearances, *that can poſſibly*
ppen elſewhere, throughout the Univerſe: *And*
aſſure the Reader, *that all whatſoever may be an-*
r'd on the ſame *Grounds*; *I have induſtriouſly*
k'd up thoſe which ſeem'd moſt odd *and* intri-
e, *and brought 'em to the Teſt of a due Examine,*
found 'em at the Bottom conformable to the
ne *Principles.*

Fifthly, *For Illuſtration's ſake, I have drawn*
Map of the Courſe of the Tide, *according to*
Common Tide-Tables, *for all that Compaſs*;
xpoſe to the Eye, the Order *and* Progreſs *of*
all, at one View; *for an Example, how to*
form the like of the Tidings *in all* other Seas,
ich doubtleſly will be executed in Proceſs of
e; *as being no leſs* Uſeful, *than Satisfactory*
he Curioſity of Mankind, tho' as yet never at-
pted: Thoſe, who drew not the Origin *of 'em*
n the Equator, *not knowing where to* begin
r Work; *and thoſe who did that, apprehending*
little how to end *it*; *Eſpecially, being all the*
le involv'd in that vulgar Error; viz. *That*
made High-water *upon the* Firſt Meridian,
here *and* there, *at the* ſame Inſtant.

Thus far I argue, from the Cauſe *to the* Effect;
That the Moon's Preſſure upon our At-
ſphere, *makes the like Impreſſion upon the*
underneath it: Again, that the Depreſſion
he Equator (*after the ſame manner*) raiſeth
eſpondent Tides *between the* Tropicks *and the*
ar Circles: *Then, that the Tumour in the*
antick *transfuſeth it ſelf on the* Coaſts of Eu-
e, &c. *And entring our* Britiſh, &c. *Channels,*

fluctuates up in the adjoining Rivers, *ſtill argu from* Univerſals *to* Particulars; *yet, ſuppoſing the while, the Conſequence to hold on the Converſ* viz. *That if* her Preſſure *be the Cauſe of Tide in* Thames, *for Example, it truly cauſeth (for their ſtrict Connexion, and free Communic tion,) in all the* Rivers, *and* Seas, *throughout World: So that what I here ſuggeſt, is not* impe fect *in its kind; but only requires a* farther *App cation to all the reſt.*

Laſtly, *It is in vain (on the Negative Part) ſearch out* other *Cauſes, to interpoſe between* Preſſure *and the* Sea, *to obſtruct its Operatio or in the leaſt to interfere with it, as a* Partner *the* Tide's *Production; or to act conſiſtently wi it, by any other Means, than (as the* Sun *does) way of* Preſſure, *without acting* Counter *to as the* Moon *her ſelf would do, in caſe her Pleni nary Light* rais'd *the Tide by* Fermentatio *while her Corporal Preſence* depreſs'd *it at the ſa Time; and the* Sun *wou'd do the like, if at once* Rarified *and* Attracted *the Flood by his Heat,* condens'd *and* protruded *it into an Ebb, in ſame Place: And as for the* Motion *of the Ear or the* Influence *of* Planetary *Bodies, being cern'd in the Work; they are demonſtrated, all, to be neither* proper *nor* ſeaſonable *to eff any ſuch thing. Now to my Task.*

Second TREATISE.

Of the Tide; or the Ebbing and Flowing of the Sea.

CHAP. I.

f the Ocean's *continual Flux into the* Weſt; *and of the Cauſe of the* Tide, *and how it is effected, according to its full Extent.*

SINCE the Motion of the Sea *in general* is divided, 1. Into a *Weſterly* one, whoſe Flux is *Perpetual*; and, 2. That of the *Tide*, which is *Periodical*, and ſtill Ebbs and Flows recipro-ly *North* and *South*: Now, purſuant to the count I have already given of the Produ-on of the *Wind*, in the *precedent Chapter*, I to proceed in *this*, (of the Motion of the) to demonſtrate what Influence the *Wind* actually upon the former, with regard to continual Devolution into the *Weſt*, as a neceſſary Preliminary, before I enter upon th Motion of the *Tide*, which conſiſts of a conſtant *Reciprocation*, Back and Forwards, between the *Equator* and the *Poles*; to ſhew, whether they have any more *Dependance* on one another, than what is meerly *Accidental*; and that the Tendence of the Former may perhaps, in ſome Circumſtances, interfere with the Courſe of the Latter.

SECT. I.

Of the continual Flux of the Ocean *from* Eaſt t Weſt, *cauſed by the* Wind; *and that its different Motion from the* Tide, *neither concur with it, nor obſtructs it, as to the Subſtance of i Motion.*

FIRST, Both Reaſon and Experienc evince, that *Wind* and *Water*, being heavy and liquid Bodies, the one floating upon th Surface of the other, they muſt, througho the *Ocean*, be every where very *Contiguous*; an by Conſequence, in ſome meaſure *Coherent*, an very loath to be parted: Hence it is, that th *Wind* inclines the *Sea*, in Compliance with i Motion, to retard or haſten its *Tides* into o *Rivers*; and the *Ocean* never ſuffers any T multuous Diſturbance within it ſelf, witho Storms of *Wind*, and *Tempeſts* of Weather i the Air to raiſe it.

Now, in regard the *Trade-Wind*, as direct by the Courſe of the Sun, blows continual *Weſtward*, and wafts over the largeſt Comp

f the Earth ; it muſt needs drive the *Surface*
f the *Ocean*, between the *Tropicks*, the ſame
ay: Hence the *Mariner*, in his *Eaſt-India*
Voyages, which lie moſtly within the Com-
aſs of that *Climate*, is forc'd to *quarter* the
Courſe of the *Sea*, as well as the *Wind*, to get
hither ; and at his Return, he makes the beſt
of his way, *both* being favourable ; or elſe his
Arrival in *Europe* would be ſo late, as to miſs
is Market.

Beſides, That vaſt Body of Salt-water,
hereof the *Ocean* is compos'd, being *Ponde-*
s as well as *Self-coherent*, muſt needs be ſlow
receiving the Motion of the Wind, and as
th to part with it ; and conſequently, the
ther its Courſe is continued towards the
ſt, the more it muſt be *increaſed*, at leaſt to
eterminate Height : Hence the *Mariner* well
ſerves, that the *Mean Courſe* of his Ship is
ghtned in the ſame Proportion ; ſailing
m *Europe* to *America* in a much ſhorter Time
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long be proportionably *advanced*, and the

longeſt Courſe muſt raiſe it to the *higheſt* Pitch
Hence it is, that the Flux of the *Atlantick*
from the *African* Coaſt to the Bottom of th
Bay of Mexico, makes ſuch Haſte thro' th
Caribees; and the *Pacifick* does the like, from
the back ſide of *Peru* thro' the *Anian Gulph*
But the Courſe of the Ocean, from the *Paci*
fick, along the *Indian Sea*, towards the *Magella*
nick Streights, being the *fartheſt* Drift, pou
down the *ſtrongeſt* Stream, and with th
greateſt Precipitation that can be found elſ
where, as falling from the *greateſt* Deſcent.

And ſince the Protuberant *Flood before* th
Wind muſt needs leave as deep an *Ebb behi*
it, yet cannot poſſibly return back exact
the ſame way, to ſupply that Vacuity; th
Protuberance muſt ſorce a Paſſage back aga
underneath itſelf, by the *Preponderation* of
own Weight, to devolve its Stream into t
Eaſt, and reduce, in ſome meaſure, the S
face of the Sea into its Natural Poſture,
an *alternate Revolution*; ſtill riſing *higher*
the one Part, and returning *faſter* towards
other; the general Surface of the Oc
mounting all the while *higher* towards
Weſt, eſpecially between the *Tropicks*, wh
the *Wind* and the *Sea* keep better Touch w
one another.

Such is the Motion of *Undulation*, that,
preſerve the Water's *common Level*) how m
ſoever it is raiſed *above* it, by Reſult from
Depreſſion; and is waved forward by *Protru*
it is as conſtantly devolv'd *back again un*
neath, by way of *Reſtitution*: And for w
of this Return, after *Marten-Mere* in *Lancaſ*
was drained to a few Inches deep; its Bot

be

ing near a Water-Level, a Guſt of Wind,
in *one Night's* ſpace, drove *twelve Hundred*
res of it to a New Ground, as having not
competent Depth of Water to devolve it
f *back again* at the ſame Time ; and there it
ain'd, till the Wind ceaſing gave it liberty
return whence it came.

Yet, in regard the *Sun* ſpreads the Influ-
ce of his Rays beyond the Limits of the
rid Zone, at once over the whole Extent
the *Hemiſphere* ; the depending *Wind* muſt,
ſome degree, affect the *Sea* with a Motion
univerſal ; that is, from the one *Pole* to the
her : Whence it is found by Experience,
t wherever there lies a *Paſſage* open *Weſt-*
rd, out of one part of the *Ocean* into ano-
er : the *Current* ſtill holds on its *Weſtern*
urſe thro' it, without any return ; as appears
the Courſe of the *Magellanick Gulph*, which
ws conſtantly out of the *Atlantick* into the
ifick Ocean ; and the *Pacifick* haſts again as
t, thro' the *Anian Streight* towards the *At-*
tick, the one near the *Artick*, and the other
r the *Antartick Circle* ; both running *Weſt-*
rd.

This Flux of the Ocean holds on *univerſally*
ſtward in every *free* and *open* Sea, where the
clivity of ſome *tranſverſe Shore* deflects not
Courſe any other way ; as it manifeſtly
s in our *North* Part of the *Atlantick* ; whoſe
th-west Coaſt of *Guiana*, from the *Mouth* of
Amazons, declineth above *Thirty* Degrees
North-Latitude, before it reach the Bottom
the *Bay of Mexico* : And the Flux of the
an bearing up againſt it all along from the
ſt of Africk, paſſeth in a Crowd thro' the

Caribees

Caribees, *North-weſt* ; and is *reflected* from the Bottom of the Bay *North-Eaſt* thro' the *Antilla's* with the ſame Violence and Precipitation, till it transfuſeth and loſeth it ſelf in the vaſt Expanſion of the *Ocean* whence it was firſt rais'd, to re-furniſh it again with its *Quota* of Water, and compleat its Circulation : an Expedien which turns doubly to the *Mariner*'s Account to fall down by the *South-Current*, from th Latitude of the *Canaries* into our *Weſtern Plantations* ; and when he is Homeward-bound the *North Channel* ſerves as well for his ſpeed return Thither.

And for an Experimental Evidence, tha ſuch a *Contrariety* of Motions is *compoſſible* i the *Ocean*, we have 'em All compriz'd withi the narrow compaſs of the *Boſphorus* ; whic has alike *Two contrary Currents*, one on th *Eaſt* Side from *South* to *North* ; and anoth on the *Weſt* from *North* to *South* ; according the different *Direction* of the oppoſite *Shores* ſo that rowing over the *Channel*, you are e ther carried out of the *Euxine* into the *Prop* *tis*, or back again, while the *Middle* Strea runs *both* ways at once ; the *Upper Six Foot* its Current (which riſeth out of the *Euxin* ſliding over the *Lower* Part of its Stream fro the *Propontis*, which forceth its way back aga all the while *underneath* ; the *Freſher* and *Ligh* Water of the *Euxine* Sea floating upon t Top, while the *Salter* and *Heavier* of the *Æ* *an* ſinks to the Bottom.

Such *Variety* of Fluxes, To and Fro, and U and Down, with their Circulation, and all the *ſame Nature*, and ariſing from the *ſ*

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uſe, being experimentally *compoſſible* and Pra-
cticable, within the ſmall compaſs of ſo Nar-
ow and Shallow a *Gullet* ; what can be ob-
cted againſt the above-ſaid *Weſtern* Flux of
e *Ocean*, and that *North* and *Southern* one of
e *Tide* (being Motions of *different* Natures,
d proceeding from *ſeveral* Cauſes *independent*
n one another,) taking their full range in the
ſt Extent of the *Ocean*, without interfering ?
t that they are neceſſary Truths, and Geo-
etrically evident, ſo as not to be queſtion'd.

The *Former*, proceeding Originally from
e *Sun's Heat* rarifying the Air, and driving
Flood into the *Weſt* ; and the *Latter* being
ſ'd by the Preſſure of the *Moon*, and toſs'd
m the *Equator* towards *North* and *South*, and
ck again alternately : *That* floating upon the
rface of the Sea all the while ; *This* diving
wn into the *Deep*, and riſing up again by
dulation ; *That* conſtantly affecting the ſame
ace, and always alike ; *This* being *Periodical*,
d making its Viſits here and there with end-
ſ *variety*, *&c.* as I have already ſhewn of
e *Former* in this *Section* ; and ſhall do the
e of the *Latter*, occaſionally by degrees,
roughout the *following* Diſcourſe upon that
bject.

Notwithſtanding, ſince we find by Experi-
ce, that *Winds* of other Sorts ſometimes *ha-*
n or *retard* the Motion of the *Tide* ; ſome-
nes *ſwell* it to an extraordinary Height, or
ate it as much ; and ſometimes drive it with
re violence againſt one Shore than ano-
r, with an endleſs variety : We muſt needs
knowledge, that the *Trade-Wind*, which has
more even and conſtant Motion than the

Reſt, *Weſtward*, ſometimes *deflects* the Courſe of the Tide from its true *North* and *South* Declination from the *Equator* ſome Points *Weſterly*; yet without ſharing in the Cauſality of its *Subſtance*, or being an *Impediment* to its proper Motion more than by *Accident*, or by way of a *Modification* to its Effect.

Juſt as a *Stone* caſt into a ſtanding *Pool*, raiſeth an *Undulation* perfectly *Circular*, which the *Stream* of a River wou'd have formed into an *Oval* Figure, by ſharp'ning it *before* into an *Hyperbole*, and blunting it *behind* into an *Ellipſis*, and compreſſing it on each Side *Parabolarly*; rendring the whole Figure an imperfect Compound of all the Curvilinear *Conic Sections*, yet without being even a Partial Cauſe of the *Undulation* in itſelf; ſo the *Trade Wind*, and the Courſe of the *Ocean* purſuant thereto, barely *Modifies* the *Tide* as to its extreme Parts, inaſmuch as it affects the *Shores*, and floats upon the *Surface* of the Water, without exerciſing any Cauſality upon the *Subſtance* of its Motion, which dives *underneath* it.

SEC

SECT. II.

at the Tide *is cauſed by the* Moon's Preſſure *upon our* Atmoſphere ; *and* how *it is effected.*

TO diſcloſe the true Cauſe of the *Ebbing*
and *Flowing* of the *Sea*, as contradiſtinct
om the *Flux* and *Reflux* found in thoſe *Rivers*
hich have an immediate Communication
ith it, and cannot be diſcover'd out of their
ecincts ; at leaſt the Motion of *Undulation*
uſt needs be admited in the *Ocean* it ſelf ; for
much as the *Flux* of the Sea neceſſarily *de-*
nds from a *higher* Station ; and the *Reflux*
ck again returns to a *Lower* than thoſe *Ri-*
rs which they affect ; and by conſequence,
e *Surface* of the Sea muſt reſpectively *riſe*
d *fall* from the one extream to the other :
ow, in regard the Sea is a *Ponderous* and *Ina-*
mate Body, the Motion of *Aſcent* and *De-*
nt, which is merely *Local*, muſt be forced
on it by ſome *Exterior* Agent, while its own
nate Propenſion to a *mean* Situation, ſtill
deavours to *re-ſettle* It in its *Natural* Poſture,
hich produceth that Alternate Viciſſitude of
eciprocation, which affects the *Tide*.

Firſt, To aſſign the ſaid *Mean*, its proper Si-
ation : For as much as Salt-Water is a *heavy*
lement, and of a *liquid* Conſtitution, its Su-
rficies muſt naturally *ſink* all over to an ex-
t *Level*, and keep its extreme Parts to an
ual Height. *Again*, in regard the Earth and
a conjoin'd compoſe one *Terraqueous Globe* ;
and

and conſequently reſpect *one* and the *ſam*
Point for the *Center* of their Gravity ; the *ſu*
perficial Level of the Water cannot be *Flat* o
Plain, but *Curv'd* or *Sphærical*, to keep its ex
treme Parts *equidiſtant* from it, and hold i
Libration on all Sides in an *even* Poiſe : Henc
it follows, that whenſoever any *Depreſſion* i
made in one Place, it muſt raiſe as *high*, o
at leaſt an *Equivalent*, Rebound in another
and both muſt be finally reduc'd to a *Wate*
Level, by the innate propenſion of its *Gravity*
and that ſo conſtantly and neceſſarily, that t
advance any *permanent Protuberance* upon th
Ocean's Surface, is ſo groſs and groundleſs a
Error,as not to deſerve the regard of a farthe
Refutation.

Hence it follows, that the Motion of th
Tide may be caus'd alike by *Alleviation* or *De*
preſſion ; for whether the Surface of the Se
be Alleviated or Depreſs'd from its *Natu*
Level ; it muſt, by the Laws of *Reſtitution*, re
turn back again *thither* with the *ſame* Forc
and Speed ; and repeat its *Undulations* to th
ſame Height and Depth ; and both ways the
muſt return back to their *Natural Level*, at th
ſame Rate, whether they be rais'd by *Allevia*
tion, or elſe by *Rebound*.

But, in regard *Depreſſion* proceeds immedi
ately and neceſſarily from the *meer Applicati*
of ſome other Body to the *Superficies* of th
Sea ; the *Preſſure* of the *Moon*, v. g. muſt
admitted for the Cauſe of the *Tide*, and is
be purſued, as far as it will go before we ha
recourſe to the *Sun's Rarefaction*, *Magnetick A*
traction, *Inexplicable Influence*, *Occult Quality*,
Motion of the *Earth* ; whoſe Exiſtence is

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her *queſtionable*, or Co-operation *uncertain*; nd conſequently, not to be admitted without he utmoſt Aſſurance of Reaſon and Experince. Hence,

Secondly, Touching the *Exterior Agent*, which s by *Preſſure* upon the Sea's Superficies, and iſeth it contrary to the *Natural* Propenſion f its own *Gravity*; the ambient *Air*, or our *moſphere*, firſt occurs to be accepted; as beg *Contiguous* and *Co-extenſive* both to Land d Sea; and *equivalent* in Weight to *Thirty bes* of Quick-ſilver in the *Barometer*; or to many *Foot* of Water; and, by conſequence, ou'd much more than ſuffice to make the *Ti*l Impreſſion; but by depreſſing the Ocean ery where at *once*, and in all Places much *ke*; it rather keeps its Surface *Steady* in its tural Poſture, than drives it into any Diſler.

And, to aſcend to the *Higher*, and more *Erial Region* of the Air, which is immediate*continuous* with the *Lower*; it cannot deſs the *Atmoſphere* more intenſely in *one* Place n in *another*, as being *equally co-extended* to Places at once, and every where *Equilibri* in it ſelf; and ſo cannot make any *Inequa* in the Surface of the Sea underneath, by its Intrinſick Power, which is ſo *indifferent* to Places, that it cannot *particularly* affect any e more intenſely than the Reſt, within the ne Hemiſphere.

However, this *Etherial Space* of the Air, nſiſting of Matter as well as Form; and beg a ſubſtantial *Body*, endowed with all its ree Dimenſions, *Length*, *Breadth*, and *Thick*-

neſs, purpoſely to take up room ; how *Thi* and *Subtle* ſoever it be, it muſt be *Condenſibl* by a conſtipation of its Parts ; and *Elaſtick* b their Relaxation ; and conſequently capabl of receiving *ſuch Impreſſions*, from any Superio *Planetary Bodies* paſſing over it, and of *tranſmitting* 'em into the ſubjacent *Air* or *Atm* *ſphere* below ; to be derived to the Surface o the *Sea* underneath ; as alſo of having 'em *taken off* again *Periodically*, to cauſe that *Ebbin* and *Flowing* in it which is called the *Tide*.

Now, in regard the *Moon* moves in the *lea* *eſt* Sphere of all *Planetary* Bodies ; and her Motion is *Concentrical* to our Globe of Earth an Sea conjoin'd ; and ſo at her *Nadir*, ſhe is *farther* diſtant from any determinate Place thereon by a whole *Diameter* of the *Earth* ; and a her *riſing* upon the *Horizon*, ſhe ſtill remain diſtant from the ſame more than *half* ſo much than after ſhe is arrived to its *vertical* Point And again, the *Lines* of her Preſſure where the are *ſhorteſt*, they become moſt *direct* and compact, to make the *deepeſt* Impreſſion upon th *Æther* ; and by its Mediation upon our *Atm* *ſphere* ; and this alſo upon the *Sea* itſelf ; and b parity of Reaſon, muſt be continued *around* th Univerſe, from *one* Meridian *Weſtward* to *an* *ther*, correſpondently to her *Diurnal Courſe* : an be ſtill *repeated* at her return to the ſame Poi *indefinitely* without intermiſſion : So muſt th *Tide* do alſo.

Beſides, the *Approximation* of her *Orb* to th *Sea* gives her power to act upon it with a *va* Energy, more than all the other *Celeſtial* Bodies which lye ſcatter'd over the Heavens at far *greater* diſtance from it ; without any *ſpe*

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al *Determination* to the ſaid Effect : And the terpoſition of *her* Sphere, between the *Sea* and *theirs*, muſt needs *obſtruct* their Influence upon the *Tide* as much : So that the Motion thereof little regards any *other* Influence beſide *Hers* ; as we find by daily Obſervation, and ſhall be fully demonſtrated hereafter.

Thus, on the one Part, as the Preſſure of the *Moon* is the moſt *proper* and *effectual* Cauſe, to produce the ſaid Effect ; ſo the *Ocean* is the beſt *diſpoſed* Subject poſſible to receive it ; as maintaining its *Spherical* and *Natural Level* merely by the *Equilibrium* of its Surface, which is manifeſtly taken away by the *Moon's Preſſure* : being ſtill reciprocally *enforc'd* upon it in *one* place, as it is *abated* in *another* ; the Element of Water (the *Matter* whereof it conſiſts) being render'd *indefinitely voluble* by the *Extent* of its Superficies, and the *profundity* of its Depth : So that, in regard neither the *Cauſe* wants Power ; nor the *Medium* due *Application* ; nor the *Subject* a fit *diſpoſition* for the Effect ; that it ſhou'd not follow is abſolutely impoſſible.

So manifeſt it is, That the vaſt Body of the *Moon* cannot be hurried from our *Nadir* up to our *Horizon*, and from thence to our *Zenith* ; and be poſted down again into the *Weſt*, and return'd to the Place whence it came, in *Twenty Four Hours* ſpace, without raiſing as vaſt a Commotion in the *Medium* thro' which it paſſeth : And that ſhe ſhou'd be ſo *nearly* obtruded upon Us, and ſnatch'd away again from our *Hemiſphere* to ſo vaſt a *Diſtance*, and with ſo great Diſlocation of the Parts of the *Medium*, to make *room* for her *Reception*, and fill it up again at every Inſtant ; yet, that this Turmoil ſhould not cauſe the *Tidal* Alteration the *Sea*'s Superficies underneath, is another *poſſibility*.

Hence the Motion of the *Tide*, purſuant her *Preſſure*, does not barely correſpond ther to, as the *Thing ſignified* to the *Sign* which preſents it ; but neceſſarily *depends* upon it, the true and real *Effect* doth upon its prop *Cauſe* ; that is to ſay, at *all Times* and in ev *Place*, according to the manifold *diverſity* of h Motion ; as is found by *Obſervation* : An foraſmuch as the *Periodical Increaſe* and *Decre* of its Floods and Ebbs, *exceed* the more co ſtant Energy of her Preſſure, both by way *Exceſs* and *Defect* ; the Difference ariſeth f from *another* Sort of Preſſure, *interfering* wi Hers, without recourſe to any other kind Cauſality, which wou'd be either *proper* *poſſible* to give her any Aſſiſtance towards t performance of her Work, either as to t *Whole* or any *Part* of it ; as will appear her after: Now, to ſhew how well qualify'd h *Preſſure* is to produce the *Tide*, as to its *Su ſtance* ; or, inaſmuch as it conſiſts in a *Me* between the Two Extreams aforeſaid ; 'tis m preſent Task to *explain* it more fully in the ne *Section*.

SECT. III.

Efficacy of the Moon's Preſſure *upon the Sea r the* Tide's *production ; and its ſeveral* Qualifications *for that purpoſe.*

O put the *Sea* in its beſt *diſpoſition* to re-
ceive the Effect of the *Moon's Preſſure* ;
poſe her *firſt* Impulſe finds the Surface of
Sea exactly *ſmooth*, and profoundly *quiet* ;
Extreme Parts ſtanding throughout in an
ilibrium, it is in the *readieſt* Diſpoſition to
ſunk *below* its *Spherical Level* ; and in the
ſt Poſture to riſe again *above* it (as a *Pendu-*
is beſt diſpoſed for Motion To and Fro,
n it hangs *perpendicularly* :) and by the *firſt*
ulſe it is better prepar'd to receive a *Second* ;
ch, being regularly apply'd ſinks the Sea's
erficies *lower* ; and gives it an *Additional*
ce to ſpring it ſelf up again *Higher* than
re : And ſo upon her *third Impulſe*, its
nt and Deſcent ſtill increaſe in a *Progreſ-*
Proportion ; till the *Active Force* of the
n's Preſſure, and the *Paſſive Reſiſtance* of the
s Superficies arrive to an *Equality* ; and
their Progreſs is at *a ſtand* : Juſt as a *Pen-*
m, mov'd by *Clock-work*, requires the *help-*
Hand of the Artificer to ſet it on foot ; and
that, it continues to raiſe its *Vibrations*
er and higher, till their Motion becomes
aſt *equal* and *conſtant* ; and ſo continues
after,

Next, the *Æther*, which intervenes betw the *Moon* and the *Sea*, being a Corporeal Su ſtance, of how *thin* and *rare* a Conſtitution ſo ver; yet it muſt grow *denſer* and harder by Co *preſſion*; not only to *tranſmit* her Preſſure up the Sea, but alſo to *enforce* it downwards, th all that ſpace; and the *quicker* the Impulſe the *deeper* Impreſſion it muſt make. Henc the great *Celerity* of the *Moon*'s Progreſs, fro her Upriſe in the *Eaſt* till ſhe reach the *M* *dian*, muſt drive all the while her Impu *more forcibly* to the Head, in that *groſs* and d Element of *Water*: As *Fire*, ſo *rare* a Subſtan as it is, diſploded out of the Mouth of a *non*, by the exceſs of its *Celerity*, makes a *lent* and irreſiſtible *Concuſſion* in the much de ſer *Air*. In like manner, the *Æther*, tho' it *rare* and *light* in itſelf, yet, by the *Moon's* *pulſe*, may make a deep *Depreſſion* on the Surf of the *Sea*; as well as the *Air*, tho' it be *Hundred Times* lighter than *Water*, prepond rates *Quickſilver* in the *Barometer*, which *twelve times* heavier than it, in proportion the Poiſe of its *own Weight*, conjoin'd w the Multitude of *Vapours* and *Exhalations*, whi it ſuſtains.

Beſides, the *vaſt Depth* of the *Ocean*, ſtooping its Bottom ſo low, renders the gr Body of Water, which it ſuſtains, more *v* *ble*, and better *diſpoſed* for Depreſſion: As proportionate *Length* and *Breadth*, by diſjo ing the *Shores*, affords its *Middle* Stream equal Liberty to expatiate it ſelf *more fr* every way. Again, whereas thoſe *Shores* a *Bottoms* are *fix'd* and ſtedfaſt by Nature; a the *Water* contain'd within their Compaſs *veable*, and cleaves cloſe to 'em on all Sides ; *e Points* of their Adheſion ſerve as *Centers*, the Lines of Water (which are *looſe* at the her End) to *turn* upon 'em, as ſo many *Ra- s*'s upon their *Axes*, which the *farther* they e extended the *faſter* they move, and the *ilier* they are ſet on foot. Hence it comes paſs, that the *Broader* and *Deeper* the Ocean he *eaſilier* it muſt ſubmit ; and the *Lower* it ſt ſtoop its Surface to the Preſſure of the *on* ; and ſtill *Lower* beyond compariſon than our *Narrow* and *Shallow* Seas, as is found by ſervation.

Again, as to the vaſt *Extent* of her Influ- ce : Her *Lines* of Preſſure (no leſs than the ms of her Light), are poured down, *He- ſpherically*, upon the *whole* Superficies of the ean at *once*, which makes their Impreſſion h *ſtrong* and *comprehenſive*, as being the *Ade- te* Effect of ſo *univerſal* a Cauſe ; and muſt extenſively affect all the *Seas* and *Tides* on *half* of the Globe at the *ſame* time, and werfully too, by their *direct* Impulſe ; as well he Beams of the *Sun*, reflected univerſally m the Earth's Superficies, ſuffice to raiſe *great* a Quantity of Water into the Air, in *Day*'s ſpace, as wou'd ſuffice to furniſh all *Rivers* in the World (according to their inary Courſe) with a *Week*'s Expence of ir conſtant Stream : Yet, foraſmuch as *ral* Cauſes are not apt to produce *particular* ects without ſome *ſpecial* Determination ; ſince the *Ocean*'s Surface cannot poſſibly rais'd or depreſs'd in *all* Places at *once* ; the Preſſure muſt *differently* affect 'em. Hence the contrary) in the Production of the *e*, Finally To *determine* this ſmart and *univer* Preſſure, to affect *ſome one* Place of the *Sea* mo effectually than the reſt ; it is farther to conſider'd, that the *Earth* and the *Moon* bei alike of a *Globous Figure*, and conſequently a *Convex Superficies* ; the *Lines* of Preſſure, ſe down from the Body of the one, muſt fall u on the Surface of the other at *all Angles* : B thoſe that fall *perpendicularly*, as being the m *direct* and *compact*, give the *ſmarteſt* Strok and make the *deepeſt* Impreſſions whereſoe they light ; whereas, the reſt which *dec* from 'em, growing more *Oblique* and rar *Diſpers'd*, ſuffer a Tumour to riſe *circularly* ab the Point depreſs'd ; which, if ſhe be at *Equinox*, muſt fall *perpendicularly* upon the *Eq tor* : And, in regard the Moon is *continuall* Motion towards the *Weſt*, the ſaid *Point preſs'd* muſt *follow* her in the *ſame* Tract ; lineally *deſcribe* the *Equator* it ſelf (as follow its direction) *Weſtward* : And ſince every neal Depreſſion muſt raiſe a *correſpondent* mour on each Side thereof ; the *Undulat* ſo raiſed muſt lye extended from *Eaſt* to *W* in Lines *parallel* to the *Equator* ; tho' t move To and Fro, with regard to *North South*.

After all, thoſe Two Waves, ſwelling *collaterally* on each ſide of that *Equin* Depreſſion, and having *free* liberty to r reſpectively towards the *North* and *South* P muſt ſtill *raiſe* and *dilate* their *Undulations* b Ways at once, as long as the Preſſure *in ſeth* ; and upon its *Relaxation* they are to *back again* into the Vacuity left behind

pon the *Equator* ; and their Motion having
quir'd its *utmoſt Celerity* by their Deſcent,can-
t *ſtop* in their Congreſs, but muſt *proceed* to
mount one joint *Undulation*, at leaſt to an
al Height with thoſe Two which rais'd it
wards the *Poles* ; as being the *Counterpoiſe* of
eir *Libration*.

So *eaſy* is the Element of Water to be
ought upon, and ſo ready and well diſpos'd
the *Spherical* Situation of the *Ocean's* Sur-
e, to receive *any Impreſſion* from an Exteri-
Agent : And withal, ſo powerful are the
vantages wherewith the *Moon's Preſſure* is
niſh'd to operate upon it : And ſo *Connatural*
he Manner of their Operation to the Pro-
ction of the deſcribed Effect, that it cannot
ſe but follow accordingly.

Or, on the contrary, to ſuppoſe that *Co-*
n of the intervening *Æther*, whoſe *Dia-*
er is equal to that of the *Moon's Orb*, and its
is as large as the *Planiſphere of the Earth*,
u'd be *contracted* in Length, by her *Preſſure*
n our Globe, its full *Semidiameter* in *Six*
rs ſpace ; nay, be *pitch'd* upon our Hemi-
ere and *taken off* again in *Six* more ; yet
Sea's Superficies, which ſuſtains a propor-
able ſhare of the Burthen all the while,
u'd neither be *depreſs'd* by the *Application*,
alleviated by its *Removal* ; nor ſuffer any
reſſion from its Impulſe, ſo harden'd by its
nity, and ſharpen'd by the *Moon's* and the
an's Convexity, (as it were on purpoſe to
e it ;) That,(I ſay) the Element of Water,
ſy to be wrought upon, and its Surface in
moſt yielding Poſture of its *Equilibrium*, and
o vaſt an *Extent*, ſhou'd, notwithſtanding,

refuſe to *reſent* the Energy of her Operatio in ſo advantageous Circumſtances ; implie that either the whole *interjacent Space*, that di criminates her *Atmoſphere* from ours, is a *m* *Vacuity*, and contains *Nothing* at all in it, d ſtructive to the Complex *Conſtitution* of t *Univerſe* : Or, that a *powerful* Cauſe, duly a ply'd to a *well-diſpoſed* Subject, ſhou'd not *eff* *ally produce* its proper Effect : which includes *Contradiction*, and is *impoſſible*. But this Po being gain'd, as to the *Subſtance* of our deſig Effect ; let us try what *farther* Advance can made for its daily *Increaſe*, from the *Conſt* and *Regularity* of its Cauſe's Applicatio Yet, nevertheleſs, the *following* Rub remains be remov'd out of the Way.

Objection *from the* Weather-Glaſs *Solv*

TO leſſen the Force of the *Moon's* Pr upon the Ocean, it is *objected* that *Q* *ſilver*, tho' it be rais'd in the *Barometer* ab *Thirty* Inches, by the Weight of the At ſphere ; yet it is not ſenſibly advanc'd *higher* in the Tube, by the ſuppoſed *Add* *nal* Preſſure of the Moon : And, wherea *Tide* riſeth not *Five* Foot at one ſeaſon, an another exceeds *Fifty* ; the *Quickſilver* not the leaſt notice of any *Variation* ; w ſeems to evince, that either it is not rais'd *Preſſure* ; or the *Quickſilver* in the *Baro* Wou'd make us *ſenſible* of the Operation.

To remove this Rub out of our way, on the
e Part ; *viz.* That the Quickſilver is not
'd by the *Moon's Preſſure* : the Mineral is
lve times heavier than Water ; and, by
ſequence ſo much harder to be raiſ'd :
in, it exceeds Water no leſs in *Conſiſtence*
n in *Gravity*, and ſo muſt be *Twenty-Four*
mes leſs voluble, by way of *Undulation* :
reover, it grows much harder to be moved
hin the ſtrict confinement of a *Tube*, of no
e than the *Fifth Part* of an *Inch* Diameter :
des the cloſe *Adheſion* it has to it on all
s at once ; as appears by the protuberance
he *Blebb* in the Middle, while it riſeth ; and
Cavity of the Depreſſion, when it falls
in ; yet all thoſe *Reluctances* are jointly to be
rcome at the ſame Inſtant, whenſoever it
is'd.

hereas, on the contrary, beſides the *Le-*
of the Water it ſelf, it is, in reſpect of the
n's vaſt Extent in Length, Breadth, and
th, indefinitely *Fluid* ; and ſo, is eaſily
d by *Preſſure*, and mov'd no leſs effectually
Undulation ; as Streams, the *broader* and *deep-*
ey are, ſtill they become *eaſier* and *ſwifter*
Motion. Hence, the *firſt* Impulſe of the
on, having made any ſenſible Impreſſion
n the Sea's Superficies, that *firſt* Commo-
is rais'd conſiderably higher by a *ſecond* ;
this by a *third* ; and ſo *progreſſively* ; ſtill
radding to the *reciprocal Libration* of the
lations ; while the Active Power of the
and the Paſſive Reſiſtance of the other
e to an *Equilibrium* ; which finds no Place
e Motion of the Quickſilver in the *Baro-*
, for want of its *firſt* Effect ; the *leading*

Pulſe being quite *loſt,* which ſhou'd occa
ſion both the Birth and Growth of all th
reſt.

Hence it is no wonder, that neither th
Preſſure of the *Moon* ſhou'd give any viſib
Riſe to the *Quickſilver*; nor the Weight o
the *Atmoſphere* breed any ſenſible Commotio
in the *Sea*: For, altho' both act by *Preſſur*
and very effectually too, when they are du
apply'd to their *proper* and *well-diſpoſed* Su
jects; yet nothing can be affected on the co
trary: For, as *a Pound* of Lead in the one E
of the Scales cannot be ſtirr'd by *Fifteen Ou*
in the other; ſo the Preſſure of the *Moon*, b
ing ſo far over-power'd by the *Weight* and C
ſiſtence of the Quickſilver, loſeth its *firſt* Stro
and for want of giving a *beginning* to its I
bration, all which follow are ſpent in va
And as for the Weight of the *Atmoſphere*, th
never ſo much increaſed, it cannot impr
any Motion upon the *Sea*, as being *equally* ſpre
over its whole Surface at once; but rat
keeps it *ſteady* in its Natural Poſture.

But, on the contrary, admit the Wei
of the *Atmoſphere* were apply'd to the O
with the ſame Advantages that the Preſſ
of the *Moon* is; and the Effect would be
vanced to a vaſt Exceſs: For, ſuppoſe
firſt Impulſe ſhou'd depreſs the Ocean's S
face *Thirty Foot*, in proportion to the Qui
ſilver's *Thirty Inches* in the *Barometer*; to ra
by Rebound, an Undulation *Thirty Foot* ab
the Natural Level of the Sea; and the *Se*
ſhould raiſe an Undulation *Thirty Foot* hig
than the Firſt; and the *Third* another as m
higher, and ſo forward; or, allowing o

a F

Foot's Abatement to every Undulation *fifteen*
es together ; and the *Product* of their Riſe
uld amount to no leſs than *three hundred*
thoms : ſo vaſt an Advantage doth the Preſ-
e of the *Moon* make of its *conſtant* and re-
lar Application to the *Sea*, as ſhall be ſhew'd
the two following *Sections* ; and ſo utterly
the Weight of the *Atmoſphere* defeated,
hout it, of any ſenſible Effect wrought up-
the *Ocean*.

And all this while, the *Objection* runs upon
double Miſtake ; *to wit*, that the *Tide* is
ſed meerly by the Moon's *ſingle* Preſſure,
m *Five* Foot to *Fifty* : Whereas, on the
ſide it is depreſs'd ſo low, by the *Additio-*
y Impulſive Rays of the Sun ; and rais'd to
t Height, by the ſpecial *Concurrence* of the
tracting *Shores* ; acting *counter* to each other
ſeveral *Seaſons* ; as will hereafter plainly ap-
r, on due Occaſions.

And if it be further *urg'd*, that neither the
luence of the *Sun* or *Moon*, by way of Preſ-
e, is as perceptible to *Senſe*, as the leaſt Blaſt
Wind; nor, conſequently, ſo able to produce
vaſt an Effect as the Motion of the *Tide*,
h all its Diverſity. It is *reply'd*; that, altho'
Weight of the *Atmoſphere* be no more per-
tible to our *Senſes*, than the aforeſaid In-
nce ; yet it is *heavy* enough in it ſelf, (did
ot *alike* ſupport us on all Sides at once) to
us ſo cloſe, and fix us ſo faſt to the
ound, that the ſtrongeſt *Giant* wou'd be leſs
e to ſtir either Hand or Foot, than to re-
ve a Mountain : And, notwithſtanding the
d's quick Motion makes a forcible Impreſ-

ſion upon our *Senſes* ; yet, were it put to as peremptory a Stop by ſome *Obſtacle*, as the aforeſaid Preſſure, is by the Surface of the *Sea* ; 'twould not ſuffice to extinguiſh the Flame of a Candle.

And, as to the Production of the ſaid *Tidal* Effect: Since the *Wind*, notwithſtanding the *Thinneſs* and *Levity* of the Air whereof it conſiſts, compared to the *Denſity* and *Gravity* of the Water which is mov'd by it, falls ſo far ſhort of matching it, as *One* does to a *Hundred* ; yet, by *beginning* to ruffle its Superficies with gentle Blaſts ; and raiſing 'em afterwards by *Degrees*, and ſtill giving 'em due *Application* all the while ; can, within a *few Hours* ſpace, diſorder the *Ocean* into ſo tumultuous a Crowd of mountainous Billows, as 'twould crack all the *Engines* in the World, to ſuſtain any one of 'em for a ſingle *Moment* : 'Tis no wonder that the ſaid *Preſſure* ſo qualify'd, as I have already declared, ſhou'd by the ſaid means of *reciprocal Libration*, and by the like progreſſive *Degrees* produce the more Periodical Motion of the *Tide* ; both as to its Subſtance and all its Diverſity, according to the different Energy of its *Application*. Thus much being alledg'd, for the Production of the *Tide* by the *Moon's Preſſure*, in general Terms ; let us ſee *how* the *different* Motions of the *Moon* reſpectively influence the *Tides* of the *Ocean*.

SECT

SECT. IV.

e Diurnal Courſe *of the Moon, and the Motion of the Tide* adjuſted; *and the Regularity of her Preſſure's Application* demonſtrated; *and how ſhe maketh a* Primary *and a* Secondary Tide, *with one Revolution.*

HAVING already determin'd the *Cauſe* of the *Tide* in general; and deſcribed e manner *how* it is produc'd : To obſerve rder and Method, I am now to give an Acunt of the Moon's *Diurnal Courſe* from *Eaſt Weſt*, as being her moſt Regular and Comon Road about our Globe; before I digreſs her *Menſtrual* and *Annual* Motions, which e Deviations from it. And, to ſpeak intelgibly,

Firſt, It is to be noted (to have but one haſe in view at once), that I place the Moon pon the *Equator*, as being the *Mean* between e *Tropicks*, which ſhe never tranſgreſſeth ove *Six* Degrees: And (to hunt down one ifficulty before another be ſtarted), I make r Motion to be *concentrical* with the *Earth*.

Next, whereas ſhe produceth *two Tides* with e Revolution; to deſcribe their Production ore exactly, I ſhew how it is perform'd graally in *four times ſix* Hours; I mean *Lunar* ours, which are about *two Minutes* ſhorter an the *Solar*.

Thirdly, foraſmuch as they are produc'd by r *Preſſure*, which cannot affect (immediately and directly), more than the *one Half* of ou Globe at once ; I aſſign 'em *Both* to the *ſam* Impulſe ; the one as its *Primary*, and the othe its *Secondary* Effect ; tho' they be produc'd afte very *different* Means.

Finally, When I ſay 'tis High-Water upo the *ſame Meridian* with the Moon, it is to b underſtood of *that Tide* which is caus'd b *Rebound* between the *Tropicks* and the *Pol* *Circles* ; as being caus'd by her *Preſſure* whic is made at the *ſame Time*, and upon the *ſam* *Meridian*, near the *Equator*. Thus much bein Advertis'd,

Firſt, It is to be conſider'd, that her Lin of Preſſure, *co-extending* to our whole *Hem* *ſphere* of the Globe at once, begin at her *riſi* in the *Eaſt*, to affect the Ocean up to o *Meridian* ; and as ſhe mounts higher towar her *Southing*, thoſe Lines are not only co tracted in Length a *Semidiameter* of the Earth but ſtill grow more compact for the ſpace o *Six Hours* together ; and fall more *directly* upo its Surface, to make a deeper depreſſion upo the Sea, between the *Tropicks*, till ſhe be a vanc'd to her greateſt *Height* ; while the *Ti* aforeſaid *Undulations* are rais'd by *Rebound* co laterally on each Side of her Paſſage ; an ſtill ſwell and dilate themſelves (to mak High-Water) towards the *Poles*, till her Pre ſure be at a ſtand.

And for the *next Six Hours*, when ſhe d clines into the *Weſt*, and withdraws her Lig and Preſſure from our *Hemiſphere* by the *ſa* *Degrees* that ſhe had advanc'd 'em ; thoſe U *dulations* muſt devolve *back* again, with as gre

Precipi

cipitation towards the *Equinoctial Line*; not
y to fill up the vaſt *Vacuity* left by her Ab-
ce, but alſo to *remount* the Water's Super-
es in the *ſame* Place, as high *above* the Oce-
s Natural Level as it was ſhrunk *below* it be-
e; that, as at her *Southing* was made High-
ter towards the *Poles*; ſo now, at her *Setting*,
s upon the *Equator*.

And in the *Six Hours* ſpace after her *Setting*,
en ſhe is haſting to the *Meridian* of our An-
odes, that *Equinoctial Tumour*, left behind
r upon the Ocean on *this Side* of the Globe,
ſt *deſcend* again by its own Weight, *as low*
rom whence it rebounded before; to make
great a *Depreſſion* upon the Sea's Superficies
our Hemiſphere, and at the *ſame* Inſtant,
t the Moon does upon *theirs*; to make two
metrically oppoſite Tides at the ſame time; there
Primary one, as caus'd by her immediate and
ect Preſſure; and here a *Secondary* one, as
s'd by the Deſcent of the ſaid *Undulation* left
on our *Meridian* at her Setting.

And in the *laſt Six Hours*, while the Moon
urns to our *Horizon*, the Sea on *our ſide*
the Globe, which was *ſecondarily depreſs'd* to
loweſt Ebb by its own Weight, rebounds
ain very opportunely to its *former Height*;
t, while the Tumour hangs as it were ſuſ-
nded in the Air, ſhe may give her *Second*
pulſe a Regular Application, to drive it
wn again *more forcibly*, in a joint Concur-
nce with its innate Ponderation: And be-
n this *Second* Revolution with more Vivacity
an it did the *Firſt*; and the *next* with more
an *this*; and ſo the *reſt* that follow progreſ-
ely, by a Circular Repetition; till they ar-

rive at that ſtint which is to be *conſtantly* main
tain'd, and as it were *repeated*, by an Alterna
Viciſſitude ever after.

For, the Moon ſtill renewing her Preſſur
and taking it off again by *equal* ſpaces of Time
at every *Six Hours* end; and this *Primary* an
immediate Impreſſion, ſetting its Stamp u
on the *Secoudary* one, (which immediatel
follows it, and is produc'd by a concurren
Depreſſion of the Water's Gravity, as bein
the *Adequate* Effect of its immediate Cauſe
each alternately *purſues* the other ſo cloſe, as t
leave no *Vacancy* in point of Time, to interven
between 'em, which the Moon's *ſecond* Impul
cannot ſupply, by the more conſtant and reg
lar Application of her *ſucceſſive* Revolutions.

But, after the Motion of the Sea be *exactl*
adjuſted, by a few ſuch Amendments, to th
common Courſe of the Moon; and the *Tid*
Undulations are rais'd to a competent Heigh
by a proportionable Number of her *repeate*
Impulſes, regularly apply'd; they *acquire*
Motion *proper* to themſelves, and becom
more *Equitemporary*; let their *Librations* be ne
ver ſo much increaſed or diminiſh'd: yet the
adhere all the while no otherwiſe to th
Courſe of the *Moon*, than a good-going *Pend*
lum-Clock does to the *Sun*; ſo as to ſtick clo
to their *mean* Motion, let the *Real* One var
how it will; notwithſtanding, ſo as ſtill to h
their ſtated Occurrences to a Point: A co
vincing Argument, that as the Motion of th
Clock has a dependance on that of the *Sun*, b
the contrivance of *Art*; ſo this of the *Tide* h
its Dependance on the Courſe of the *Moon*, b
the Order of *Nature*; yet all this while, wi

d

regard to *Another* of their own, to *Qualify*
And it is no leſs neceſſary, than that the
reaſe and Decreaſe of *Day* and *Night* ſhou'd
end on the *Riſing* and *Setting* of the *Sun* ;
the different Conſtitutions of the *Four*
arters of the *Year*, on his reſpective Arrival
he *Four Cardinal Points* of the *Zodiack*.
Thus far the Motion of the *Tide* is adjuſted
a *Mean* Time with the *Diurnal* Courſe of
Moon, whereon it depends ; and (foraſ-
ch as is yet conſider'd) it ſhou'd keep to a
ſtant Height ; but being found by Obſerva-
n to fall ſhort of it at *ſome* Seaſons, as much
it exceeds it at *others* : It is next to be exa-
n'd,

SECT. V.

w the Tide's Menſtrual Increaſe *is cauſed by*
the Concurrence of the Sun's *Influence with the*
Moon, *at her* Change *and* Full ; *and* it's De-
creaſe *for want of it, at her* Quadratures.

THUS far I have deſcribed the conſtant
Courſe of the *Tide*, as depending ſolely
on the Preſſure of the *Moon*, turning Con-
ntrically about the Earth ; and making the
pending *Tides* conſtantly *equal*, without any
riation : Now, in regard the *Menſtrual In-*
aſe of thoſe *Tides* conſtantly makes *higheſt*
oods, when ſhe is either in *conjunction* with
e Sun at her *Change*, or in their *oppoſition* at
er Full ; And the Decreaſe is at its *loweſt* Ebb
when

when ſhe is in her *Quadratures* ; thoſe Flo
and Ebbs muſt be influenced by 'em *both* ;
Floods, by way of *Addition*, and the Ebbs,
Subſtraction ; that neither an Effect may
put without a ſufficient Cauſe, nor the Ca
may loſe its proper Effect.

Again, foraſmuch as *Light* and *Heat* are
chief and moſt powerful Influence of all P
netary Bodies ; and the *Sun* particularly
ſtinguiſheth himſelf from all the reſt, in bei
the Sovereign Origin of 'em *both* ; I am
demonſtrate that his Rays, as impregnat
therewith, are the moſt efficacious and pro
Cauſes to produce the ſaid *Tidal Variati*
and withal, that the Ocean is as well diſpo
to receive 'em.

Firſt, Concerning the Sun's *Light* ; its M
tion being progreſſive, and the Partic
whereof it conſiſts extreamly ſmall, it paſſe
thro' the Air down to the *Sea*, as thro' Gl
or Cryſtal, without any great Impedimen
yet ſince we find it ſtrongly reverberated
its *Reflection* from the Ocean ; we may ſafe
infer it to be *ſtopt* in part, and reſiſted cor
ſpondently, in its Career, by the Oppoſition
the *Salt-Water*, as well as of any other ma
rial Subſtance ; and to faſten Strokes upon
of a *determinate* Force ; and what it wants
Weight, it redoubles in Effect by the *Celerity*
its Motion ; and by this means, acts moſt po
erfully upon the Organs of *Animals* ; a
drives, as it were, Wedges of Heat into t
Hearts of Plants, and Things Inanimate, a
ſeparates their more Solid Parts : All which a
confeſſedly the Properties of *Bodies*, and c

on

ly belong to Material Subſtances ; and con-
uently enable it to operate upon the *Sea*, as
e Body does upon another ; and powerfully
o, by due *Application* thereto.

Again, the *reflex Heat* of the Sun ſeconds
e *direct Preſſure* of his Light with a retorted
ulſe upon the Sea ; by raiſing *Vapours* and
halations into the Air, that gravitate upon
Surface of all Liquid Bodies ; to that De-
e, as to raiſe the Quickſilver in the *Barome-*
by the preponderation of the *Atmoſphere*,
m 27 *Inches* (the ordinary Weight of the
mmon Air) up to 31, (which is the *Additi-*
Preſſure caus'd by the Energy of the Sun's
at) as is found by Experience ; the Over-
s of thoſe *Four Inches* of Quickſilver being
uiponderous to *Four Foot* of Water ; and
ivalent to the Preſſure which it impoſes
on the Surface of the Sea ; in proportion to
Power it actually exerts ; which amounts
the Preſſure of *Four Foot* of Water, ſpread
r the *whole* Surface of the Ocean.

Beſides, thoſe Vapours and Exhalations,
en they are rais'd, grow *more Ponderous* by
ir *recoil* againſt the Impulſe of their Mo-
; as a Pound of *Lead*, while 'tis only kept
dy in the Air to the *ſame Height*, weighs
more than a Pound ; but if it be lifted
her, increaſeth its Preſſure proportionably
the increaſe of its Motion ; as, on the
trary, if it be let fall again, its preſſure
eaſeth as much, till at laſt it weighs no more
n a *Feather* : Moreover, ſince the Sun
nds *not one half* of his Diurnal Revoluti-
in raiſing the ſaid Vapours and Exhala-
ns, as we find by experience, in the *Dews*
which

which fall again *betimes* in the Afternoon ; th
Energy of his Operation ſeems conſiderab
improv'd, that can raiſe ſo vaſt a Weight
High, in ſo ſhort a Time.

Secondly, That the *Sun*'s Influence may n
fall ſhort of producing its proper Effect up
the *Sea,* for want of due *Application,* 1. H
Heat and *Light* ſpread themſelves over our H
miſphere, as *univerſally* as the Lines of *her* Pr
ſure do. 2. And alſo affect the Surface of t
Ocean more intenſly between the *Tropicks,*
depreſs it by their Impulſe more effectuall
and as remiſly towards the *Poles,* to give it f
liberty to rebound more freely *there* : Beſid
the Force and Efficacy of his Influence i
creaſeth equally with hers, till *Noon* ; and is
quite taken off again, before *Night* ; and
different Seaſons of the *Year,* what each
ſpectively gains at *one* Seaſon it loſeth
another.

But, on the contrary, the different *Peri*
of their *Diurnal* Revolutions divide and we
ken the Efficacy of their Force, for want o
due concurrence to produce the ſame Effe
for, at their *Conjunction,* his Rays and and h
Lines of Preſſure, following the *ſame* Di
ction, ſend down jointly their moſt *direct* a
compact Force, to raiſe the *higheſt* Flood
the *loweſt* Ebb ; but the *next* Day, coming n
both up *at once* to the ſame *Meridional* Poi
their Force being *divided* they fall ſhort
their former Effect, by a *Sixth* Part ; and
their *Third* return, *more* than that ; and ſo p
greſſively for *Seven* Days together, till the E
of the *Firſt Quarter* ; the Motion of the T

ill adhering to the Courſe of the *Moon*, as is
ound by Obſervation.

But after her *Quadrature*, till their *Oppoſition*,
His Strokes of Light and Heat, and Hers of
reſſure, fall upon the *Diametrically-oppoſite* Un-
lations; and as diverſly affect 'em, in their
ifferent *Hemiſpheres* ; hitting 'em daily more
rectly, and advancing 'em higher and higher,
means of Depreſſion ; till the *Plenilunary*
de reach the height of That, at her *Change* ;
o' the *Manner* of their Operations be very
fferent : For, whereas at her *Change*, they
ve, with *united* Force, in effect, a double Im-
lſe with one ſingle Stroke, to *one* and the
me Undulation, letting its *Oppoſite* paſs diſre-
rded : Now, on the contrary, at her *Full*,
ey give their Strokes ſingle and apart, to
h of the Diametrically *oppoſite Meridians* ; to
fect *both* the Emergent Undulations at once,
d raiſe 'em to their *Novilunary* Height ; by
oducing the *ſame* Effect as before, tho' by a
ite *different* Manner of Operation : Juſt, as
en a *Pendulum* is mov'd by a *Clock* ; it mat-
s not, as to the *Effect*, whether it be toſs'd
ly *One* way with a *double* Force, or *Both* ways
h a *ſingle* One ; for, in both Caſes, its *Vibra-*
s are kept up to the *ſame* Height.

Laſtly, While the Conſtitution of the Sea
ntinues in its *laſt Diſpoſition*, for this *new*
preſſion of the *Sun*'s Influence ; and the
e is kept Actually in Motion by the Preſ-
e of the *Moon*'s *Diurnal Courſe*, to receive it ;
thing elſe can be required to raiſe it, *at due*
ſons, to a Height extraordinary, beſide the
's ſaid Influence, ſo apply'd.

As, when we have put a *Pound* into one End of the Scales, and endeavour to raiſe it, by caſting *Ounces* into the other ; tho' it ſtirs not, till the Addition of the *ſixteenth* Ounce brings both Ends into an *Equilibrium*, and the *ſeventeenth* overcomes the Friction of the *Axis*; yet after That, every *Scruple* that is added gives an *Increaſe of Velocity* to its Motion : So in our preſent Caſe, be the Super-influential Power of the *Sun* never ſo weak ; yet, *aſſiſted* by the aforeſaid Advantages, of a Regular *Application*, it ſufficeth to advance the *Ordinary* Height of *Tides* (which are already put into Motion, and kept on Foot, by the *Diurnal Preſſure* of the *Moon*) to an *Extraordinary* Height ; and ſerves to diſcriminate Each from Other, with that indefinite Variety of *Increaſe*, forward, till thoſe Luminary's *Conjunction*, or *Oppoſition* ; and of *Decreaſe*, back again, till her *Quadratures* ; ſucceſſively, thro' their *Menſtrual* Revolutions.

But, leſt the Height of the *Tide* may ſeem too much Advanc'd at the *Change* and *Full* above that which happens at the *Quadratures* to be rais'd within the Space of *ſeven Days*, by the additional Rays of the *Sun* : It is farther to be conſider'd, That the Force which they add to the Preſſure of the *Moon*, (by their Concurrence at her *Change* and *Full*), for the Increaſe of the *Tide*, is not only *ſubſtracted* a her *Quarter-floods* ; but directly occurs, in the ſame meaſure, to *ſuppreſs* it ; ſo that the *Sun's* Influence cauſeth different *Tides*, at *contrary* Seaſons, in a *double Proportion* to its *real* Force; inaſmuch as it does not only *withdraw*, what was *Auxiliary* before ; but renders it afterward *Adverſe* to the ſame Degree, by a *contrary* Application.

Hence it comes to paſs, That the *Menſtrual* Increaſe of the *Tide*, according to its whole Extent, *doubles* the Higheſt, which the *Sun's* ngle Force cou'd directly give it: Foraſmuch in the *Firſt ſeven* Floods, after the *firſt* or *laſt Quarter*, it only takes off the Impediment of he *Oppoſition*, which is made to the Riſing of hoſe *Quarter-floods* to their uſual Height: Whereas afterwards, for the other *ſeven* before r *Change* and *Full*, by the joint *Concurrence* of His Influence with Hers, they be as much *advanc'd* above it; and ſo by acting *counter* to itlf at *different* Seaſons, coextends to the *whole* Effect by its *contrary* Application, as aforeſaid.

Beſides, the ſuperadded Aſſiſtance of *Inclining aſts* and *Shores*, (which affect not the *Neap-ides* at all, that can hardly reach 'em); helps to iſe Theſe more *Advance Floods* to that extradinary Height; as will more fully appear ereafter.

SECT. VI.

w the Sun's *and* Moon's Annual *Courſes thro' the* Zodiac, *jointly diverſify the Depending* Tides, *and raiſe the* Equinoctial Tides *higher than the reſt.*

N the Two precedent *Sections* has been ſhewn, *Firſt*, The Application and Efficy of the *Moon's Diurnal Preſſure*, to raiſe and ntinue the Common *Tide* to its conſtant eight. *Secondly*, How effectual the Acceſſory ght and Heat of the *Sun* has prov'd, for Dirſifying thoſe *Tides*, by way of *Increaſe* and

Decreaſe reſpectively, to their *Monthly* Aſpects. Now, concerning their *Annual* Courſes, thro the Obliquity of the *Zodiack* ; It is farther obſerv'd, that all along their Progreſs, from th *Tropicks* to the *Equator*, (where they ſend dow their moſt *direct* and *compact* Influences, an take their *largeſt* Compaſs about Our Terraqueous Globe) ; they jointly raiſe the Intervening *Tides*, by ſucceſſive Degrees, till the reach their *Equinoctial* Pitch, which ſurmoun *all* the reſt ; according to the Theory of th *Tide*, laid down already on ſeveral Occurrences, in former *Sections*.

But, to ſupply *Now*, what was omitted *Then* It is farther to be conſider'd, that the Planetary Motions being *Elliptical*, and conſequentl their Influences *more* and *leſs* Intenſe, accord ing to their ſeveral *Diſtances* from Us ; eve the *Equinoctial Tides* may be *augmented* by th Moon's *Perigeum*, and the Earth's *Perihelion* and their *Apogeums* and *Aphelions*, may Anomalouſly *diminiſh* them as much, whether they b *Conjunctively* taken, or *Apart*, as it ſhall happen to an Indefinite Variety.

Again, Foraſmuch as Strokes of the *ſame d rection* make deeper Impreſſions, than tho that are *diſperate* ; and the *Moon* ſticks not cloſe to the *Ecliptick*, as the *Sun* does : Upo every *Approach*, or *Declination*, ſhe makes h Strokes more or leſs *Effectual*, upon the Se Surface : Beſides, as by their Acceſs to the S and Receſs from it, their Courſe, with reſpe thereto, is either Accelerated, or Retarded ; t Motion of the *Tide* muſt, in ſome meaſure, ſo too ; with ſeveral other *Anomalous* Differences, both of *Exceſs* and *Defect* ; which are rath an Object for piercing Wits to diſcover, and for acute *Speculation* to manage; than a fit Subject for dull *Experience*, and ſhort-ſighted *Obſervation* to be employ'd about ; ſo that they may here be well omitted, where nothing more than *Brevity* and *Clarity* is intended.

But, what falls within the Cognizance of them *Both*, is, that the intervening *Æther*, (by whoſe Means the Preſſure of the *Moon* is ſuppos'd to affect the *Sea*,) is of a *yielding* and *compreſſive* Temper ; and withal, the Body of *Water* which is affected, of a *ponderous* and *liquid* Conſtitution : Hence, the conſequent Motion of the *Sea*, cannot be ſuppos'd to keep *exact* Touch with the Impulſe of the *Moon* ; but the *Tide* which is rais'd, muſt fall ſhort, both in *Height* and *Speed*, of the deſign'd Effect : And upon every *Allteration*, either of Speed or Caſuality, it muſt rather obſerve Her *Mean* Motion, than Her *Real* Courſe : As a long and heavy *Pendulum*, little regards the *Unequal* Draught of the *Clock* ; but rather ſticks to a more regular *Swing*, in due proportion to its *Length* and *Weight*, to keep the *Index* to an exact Time.

Moreover, When the Motion of any Liquid and heavy Body, is *gradually* Increaſed, by the Aſſiſtance of *Reciprocal Libration* ; it will *go on* increaſing, tho' not at the ſame Rate, after the Force of the Mover begins to *abate*, till it come up to an *Equilibrium* with the Remainder : Hence, the *higheſt Tides* regularly happen, *two* or *three Days* after the *Change* and *Full*, when the *Force* of the *Moon's* Preſſure begins to *decay*, if they meet not with ſome *Anomalous* Impediment, to ſtop their Career.

The *Concluſion* is, that the *higheſt Tides* poſſi-ble muſt happen of Courſe, when the *Sun* i at his *Equinox*, and the *Moon* upon the *Ecliptick*, and withal in her *Perigeum*; *three* or *four Da* after the *Change*, or *Full*; and muſt ſwell Higheſt, either upon the *Equator* at their joint Concurrence from the *Atlantick* and *Ethiopick* Oceans; Or, as I conceive, about 45 *Degrees* o *North* and *South* Latitude, where their *Collater* Tumours moſt abound: And this *Recapitula* *Inſtance* will ſerve well enough, to remind U of the *Cauſes* already aſſign'd, for the *Increa* and *Decreaſe* of the *Tides*; from the firſt D *preſſions* made upon the Sea, to their full Advance to their *Equinoctial* Height.

But to proceed farther, to weigh the ju *Advantages* of the Power, which the *Sun* an *Moon* have to Act; and the due Diſpoſition o the *Air*, which is the *Medium* that both co veyeth and enforceth their Influence upon t *Sea*; as alſo the Capacity of the Subject, *Wat* to receive the Effect; with a Liberty to ma ſuch *Additions* and *Subſtractions*, as the *Rules* Art direct, and the *Laws* of Motion allow: plainly appears, upon the Principles alrea laid, and the Method which I have follow' that the Motion of the *Tide* hath ever adhere and muſt ſtill ſtick cloſe to the *Courſe* of t *Moon*, (in concourſe with That of the *Sun*) *Days*, *Months*, and *Years*; One *Age* after An ther, without any Obſervable Deviation.

* * *

CHAP. II.

Of the Tides of the Ocean, *as being bounded by* Coaſts, *and* Shores.

SO punctually, as I have already demonſtrated, wou'd the Motions of the Tide obſerve the Courſe of the *Sun* and *Moon*; and all their Diverſities might as exactly cor- eſpond to each other, according to the *Scheme* I have drawn,if the *Extent* of the Ocean's Superficies were *boundleſs*; and ſpread *Univerſally* over he Face of the whole Earth; to receive their mpreſſions in full Meaſure, and comply with heir Influences without any Reſtraint: But, n the contrary, the Ocean being actually *con- i'd* on all ſides, by *unequal Shores* and *ſhoaly ottoms*, to intercept its Motion, before it be- in; and likewiſe to interrupt its Courſe, be- ore it ſhould end; *diſordering its Undulations*, ith irregular To's and Fro's all the way: I m to proportion my Meaſures accordingly: o as to make it plain, That, when all Cir- umſtances are duly conſider'd, the whole Di- erſity of the Tides, ſo cauſed throughout the orld, is fairly accountable, and without uch Difficulty deducible from the ſame Prin- iples.

SECT. I.

High-Water ſtated at the Interſection *of the* Equator, *and the* Firſt Meridian; *as being the Place leaſt obnoxious to any Confinement, by* Neighbouring Coaſts, &c.

NOW, to purſue the ſtrict Dependance of the Tide, eſpecially upon the Moon, under the aforeſaid *Confinement* of the Sea; and ſpeak more particularly upon that Subject, as to Matter of Fact: I muſt fix the *Center* of my Obſervation and Diſcourſe, on that Part of the Ocean, where the *Firſt Meridian* cuts the *Equator*, at Right Angles; as moſt abſtracting from the various *Irregularities* of Shelves and Shores; or, That Great *Meridian*, which divides the *Atlantick* and *Ethiopick Ocean* jointly, at the moſt equal Diſtance from thoſe Three Parts of the World, which confine it; from *America*, on the *Weſt*; and from *Europe*, and *Africk*, towards the *Eaſt*: (the Ocean lying open there, towards the *North* and *South* from the *Equator*, as far as the *Artick* and *Antartick Polar Circles*:) To ſtate aright the Flux, and Reflux of all the Tides, that either depend upon it, or have any Analogy to it, in other Places.

Having therefore firmly eſtabliſh'd, in my precedent Diſcourſe, that the Preſſure of the Moon cauſeth the conſtant Motion of the Tide; Again, that her Preſſure ſtill *increaſeth*, till ſhe reach the *Meridian* of any determinate Place; and farther, that it is moſt intenſe up-

on

the *Equator*; and after all, I have ſhewn at
eſent, that the *Ocean*, upon the ſaid *Point*, is
ſt *diſpos'd* to receive the Impreſſion: Hence
may ſafely conclude (ſince as often as the
ſe is actually put, and *Subject* well diſpos'd,
Effect muſt neceſſarily follow;) That it is
w-Water upon the ſaid *Point* of Interſection,
often as the Moon arrives to *that Meridian*;
ich is the Poſition to be prov'd.

Now, to reverſe my Diſcourſe, and argue
the *Effect* to the *Cauſe*; it is conſtantly
d by Obſervation, that it is *High-Water*
ards the *Pole*, (*v. g.* in our *Northern* Lati-
of *England*,)upon the ſaid *Meridian*, when
Moon is alſo upon the *ſame Line*, at the
ator; and by conſequence, the Ocean muſt
oſt depreſs'd *there*, to raiſe the Tide *here*
eſult, from that Depreſſion, as its proper
ſe; ſince the Surface of the Sea cannot be
in one Place, without an *equal Depreſſion*
other: So that, whether we argue from
Cauſe to the Effect, or the Converſe; the
is concluded as before, in the way of
n: And our farther Recourſe muſt be to
gators, and their *Pilots* for Inſtances, to
the ſame by plain *Experience*, and Matter
act.

§.

eſtabliſh this great and important Truth,
ecourſe to the *Mariner's Obſervation* for
er of Fact; the *Streight*, wherein the Ex-
ent is to be made, lying between *Guiana*
erica, and *Guinea* in *Africk*; the *Engliſh*
belonging to thoſe Places, ought to be
con-

conſulted ; at what Hours, the Water flows both Sides of it ; to gather thence *how*, a *when* the middle Channel, more, or l abounds with Water : And to begin with *Weſt-Indian Pilot's* Account, which is the ſho er, and of quicker Diſpatch : He informs that

‘ Before the *J. Cajana*, which lieth Five D ‘ grees to the *Northward* of the *Equator*, a ‘ about Twenty Degrees to the *Weſtward* of ‘ *Interſection* aforeſaid, an *Eaſt* and *Weſt* M ‘ makes High-Water there, on Change and F Moon Days ; which is the only Inſtance t he produceth of the Flood, within *Eight grees* of the *Equinoctial Line*, on that Side, that can be concern'd in our preſent Enqui

But, to come up cloſe to the *Line*, a about Five Degrees nearer the ſaid *Interſecti* the Flood, as all *Navigators* obſerve, fills Mouth of the *R. Amazones* at VI¼ ; or a Qu ter later than the *J. Cajana* ; the Entrance the former River being much *larger*, and of Iſlands with Inlets, to take up more Ti before they be full : And it cannot be doub that the ſame *Atlantick* Flood, alike affects *Braſilian* Shore, all along from thence to C *Roque*, (its utmoſt *Eaſtern* Point,) with nea *Eaſt* and *Weſt Moon* ; that is, at VI, or th abouts.

And paſſing over the Streight, to the op ſite Shore ; our *Guinean Pilot* preſently info us ; Firſt, ‘ That at River *Serbera*, upon ‘ Edge of that Coaſt, the Water flows wit ‘ *Eaſt and by South Moon* ; that is, at VI⅔ : ‘ (following the Shore to the *Eaſtward*,) an ‘ *Moon* makes High-Water at *Swine*, at nd a little farther, at *Gojavan*, a *N. E. and y Eaſt*, and an *E. N. Eaſt Moon*, makes the ater flow at III ⅔, and at IV ½ : And paſſing long the ſame Coaſt to *Caran*, an *Eaſt Moon* loods there, at VI ; as alſo an *Eaſt and by outh* one, at VI ⅔: At *Bening*, an *Eaſterly Moon* fills all full, at VI : And at *R. Rey*, an *aſt Moon*, and an *Eaſt and by South* does the ike at VI, and VI ⅔: At *Bato*, and *Camaroon*, n *Eaſt*, at VI : At *Monamba's Hole*, an *Eaſt*, nd an *Eaſt and by South Moon*, at VI, and VI ⅔: t *R. Danger*, an *Eaſterly*, about VI : And ſtly, that at *R. Gabon*, upon the Equinoctial ine, an *Eaſt and by N.* makes the Flood, at ⅔; which includes all the reſt,(one except-) both for *Time* and *Place*, as will be ſhewn eafter.

SECT. II.

eflections *upon the precedent Account of the Tides, near the* Equator, *in the Channel between* Guiana *and* Guinea.

HAving already conſulted both *Reaſon*, and *Experience*, about the Time of High-ater, as far as both can aſſure Matter of ct, upon the Coaſts of *Guiana* and *Guinea*, ar the Paſſage of the *Atlantick* and *Ethiopick ean's* Intercourſe between them : I am now make ſome *Reflections* upon the paſs'd Ac-unt, for the farther Elucidation, and Eſta-ſhment of ſo important a Point ; which

ſuſtains the whole Frame of my followi
Diſcourſe upon that Subject.

Firſt, It is obſervable, that *Six* of th
Thirteen Places, which the *Pilot* for *Guinea*
marks, have High-Water abſolutely at
without any Variation: to wit, *Cajana*, *Swi*
Bening, *Bato*, *Camaroon*, and *Danger*; whic
being ſo well agreed, and near an equal Nu
ber with all the reſt, which are divide
ought to render *that Hour* regular, and to
obſerv'd: Beſides, *Four* of the Diſſenters ma
but *Half-Tides* at different Times; as *Serb*
Caran, *Rey*, and *Monamba*; which ſwell at
and withal at $\frac{1}{4}$ after; which plainly proce
either from the *Unevenneſs* of their Shores,
the *ſhoaly Bottoms* which retard 'em: And as
Two, of thoſe *Three* Diſſenting Rivers; to
Gabon, and the *Amazones*, which are more
ſitive in their Miſtake, and remain unaccou
ed for; the *Former*, makes at V $\frac{2}{3}$; and
Latter, at VI $\frac{1}{4}$.

Whence it is to be noted, that at all
abovesaid *Thirteen* Places, (*Gojavan* excep
the Sea is full, either *exactly* at VI, (their c
mon *Standard*;) or within $\frac{1}{3}$ before VI, or
ter it.

A Difference ſo inconſiderable, and the
equality of the Shores, which occaſions it
moderate; as to divert the depending T
neither Way, from the *Riſing* (and *Setti*
Moon, above *Forty Minutes*; for all that T
of Sea, between *R. Gabon* and *J. Cajana*, f
Eaſt to *Weſt*, above *Twelve Hundred Leag*
yet at *Gojavan*, it floods at III $\frac{2}{3}$, and I
which is ſo prepoſterouſly *early*, and with

diſa

greeable to its Fellows, that it merits an caſional *Conſideration* extraordinary ; and h as is by no means applicable to any of reſt. Now t is obſervable, that, to heighten this Irre- rity, and withal to remove the Difficulty ; *R. Swine*, which lies next before it, flows iſely at VI ; and *Caran*, which follows after it, at VI $\frac{2}{3}$; their Shores being ty equal, direct, and free from Shoals ; et the Coaſting Current, when it brings Tides along with it, paſs ſmoothly by without any Impediment ; whereas, on contrary, the *Mouth* of the *R. Gojavan*, ch gapes wide open to receive the Flood, *C. Palmas*, which ſhoots it ſelf *fartheſt* into Sea beyond all other, cloſe behind it; and s the Coaſting Current the moſt perem- y *Check* ; and the firſt *Eaſterly* Turn, along Coaſt of *Guinea*, after it has left *Braſile* ; backs the Flooding Stream into the River, greateſt Force and Precipitation ; ſo as to l its Tumour, upon the firſt Appulſe to Shore, by *Reſult*, ſo much *ſooner* and *high-* as not to be ſupported any longer to the e Pitch, after the Energy of that firſt Puſh ver.

nd the Flood, (as we are inform'd from the ervation of an Ingenious Friend,) makes as oſterous Haſte at *J. Cajana*, where it ls at IV ; the Current driving it ſtrongly, *overhaſtily* upon the Shore ; yet, according to our *Weſt-Indian Pilot's* Account, it is full, *aloof off the Coaſt*, till VI ; where it inues Riſing all the while, till it be at Quarter-Ebb *cloſe at Land*, where it ſwell'd

higheſt before : And the like happens at ot
Places, on the like Occaſion ; as will be m
appear hereafter, by many Examples : ſo ef
ctually does that *moſt Irregular* Tide wit
the Compaſs of our Obſervation , contrib
(when the Anomaly of *Currents* and *Shor*
adjuſted) to our preſent Satisfaction. Hen

It is farther obſervable, that the Flood p
ſues her Diurnal Courſe ſo cloſe, as to af
no Two Places, of an *Eaſt* and *Weſt* Poſiti
at once ; but one after another ſucceſſive
from *R. Gabon* to *J. Cajana* ; Flooding th
Meridians all along reſpectively , at her *Ri*
(and *Setting*) Inſtants.

Now, in regard the Ebb, keeps at the ſa
Six Hours diſtance from the Flood , that
Southing Moon does from her *Riſing* and
ting ; it muſt be *Ebb* at her Southing , wh
it was *Flood* at her Riſing before ; thro'
that Tract of Sea, with the ſame Order
Succeſſion ; as well in the *Paſſage* aforeſaid,
the Intercourſe of the *Atlantick*, and *Ethio*
Oceans ; and with the ſame Moon , that
been already remark'd upon the *Guianan*,
Guinean Shores ; from *R. Gabon* to *J. Caj*
for *Four Hours* Difference of Time, and *Tw*
Hundred and Eighty Leagues Diſtance of Pla
as aforeſaid.

After all, ſince the joint Obſervation of
Two *Pilots* , co-extends to *Sixty Degrees* u
the Equator , and *Four Hours* upon the Ho
ſcope ; and affects both the *Land* and *Sea*
termix'd, of all ſorts of Poſitions; the Mo
of the Tide being adjuſted thoughout to
Diurnal Conduct of the Moon ; the ſame
ſervation may, by Parity of Situation, be

pl

to all *other Seas* and *Shores* around Our
e; whether they lie ſhut up by Land, as
Ethiopick and *Indian Oceans* are by the *Gui-*
and *Arabian* Shores, towards the *North*;
the *Atlantick* is by the *Braſilian* and *Guia-*
Coaſts, towards the *South*: Or elſe lie open
both Latitudes, as the *Pacifick Sea*, and the
ht aforeſaid, do towards *North* and *South*:
he Concluſion ſtill holds, that *there muſt*
s be Low-water upon the Line, *whereſoever*
Moon is vertical; in caſe there be Sea-room,
r towards the *North*, or *South*, or *Both*, to
a Tidal Impreſſion.

ow, in regard the Tide by this Account,
thus Summ'd up, ſtill *Flows*, on the ſaid
ſection, at the *Moon's Riſing*; it muſt con-
ntly do the like, upon the ſame Point, at
etting alſo; as being directly *Oppos'd* each
her, both in Time and Place: So it muſt
be at its *Loweſt Ebb*, when ſhe is advanc'd
e ſaid *Meridian*, as being the *Mean* between
Two *Extreams*; as alſo on the *Oppoſite* to
the *other Hemiſphere*, for the ſame Reaſon;
pon all other *Meridians*, and *Parallels* be-
n the *Tropicks*, upon her Approach to
Her Preſſure conſtantly attending her
nce, in all Places, without exception:
foraſmuch as every *Depreſſion* between the
ks, muſt raiſe a correſpondent *Reſult* col-
lly, towards the *Polar Circles*, upon the
Meridian; it muſt reſpectively make
water at once, in both *North* and *South*
des, when ſhe reacheth their *Meridians*,
re be Sea-room for that purpoſe. Let us
Firſt, By Experience, that *there is* actu-
ally

ally ſuch a Reciprocation of Tidal Tumo in the Sea ; and ſhew, *Secondly*, By Reaſo the Mannor *How* it is really Effected.

Sect. III.

How the Tide is ſtirr'd up by Preſſure, *and co nued by* Libration ; *and* whither *it extends ſelf, before it makes its Returns.*

HAving found by Experience, that i *Low-water* at the *Equator*, when the Mo is actually *Southing* upon the ſame *Meridian* Our *Northern* Latitude of *England*, as bei *ſtoop'd There* by her Preſſure, upon the Point their Interſection ; and that, as the Tide rais'd *Here* at her *Southing*, by *Reſult* ; ſo it m needs be *let fall* again at her *Setting*, when h Preſence is withdrawn which ſupports it ; a ſo be ſet on, and taken off again *interchangea* at every *Six Hours* End, by *Libration* : And nally, that the ſame *Six hourly Reciprocation*, m (thro' the Analogy of *Their* Seas and Flo with *Ours*) be punctually obſerv'd all the Wo over : Hence it occurs to deſign its *Periods Place*, as well as *Terms* of *Time*, both Here a Elſewhere ; and to ſhew *how* its Librations a perform'd, and *how far* they are extended, bo in Our *North Atlantick*, and in the *other* T Diviſions of the Ocean.

Now, to conſult Reaſon, as well as Exp ence ; the *One End* of the *Tidal Balance* m Riſe and Fall, immediately upon the *Equat* where the Preſſure of the Moon firſt ſets *ration* on Foot, both in Ours, and all the aforeſaid: And the *Other End* is to be Exnded as far as the *Bottom* of the Ocean (which *erberates* the Motion of its Reſults) directs according to the *Rules of Reflection*: So that *deeper* the Bottom lies, the Tidal Tumour ſt Reſult at a *greater* Diſtance from the ce depreſs'd. Hence, its Depth being *Unhomable*, farther Recourſe is to be had for ſaid Diſtance, to *Obſervation*; which finds Flood to ſwell *higheſt* between 45 and 50 *rees* of both *North* and *South Latitudes*: So t 24 or 25 *Degrees* (near the *Tropicks*) being *Mean* between thoſe Two Extreams, to , the *Equator* and the ſaid *Parallel* of 45 or *Degrees of Latitude*; it muſt be the *Axe*, ereon the ſaid *Tidal Balance* turns, to make Revolutions accordingly.

To begin (for beſt Acquaintance ſake) with Search of the *Atlantick Ocean*; the Tide is nd to run-higheſt, on the *European ſide*, on Coaſts of *France* and *Great Britain*, between and 55 *Degrees* of *North* Latitude; and on *American* Shore, it grows higher from *Terra rida*, along the *Virginean Sea*, and decays not it reacheth *Davis Streights*; but is contid even beyond 'em, by the favour of the *ining Coaſts*: And altho' the Flood, which he Counterpart of its *Libration* in that *Ocean*, r the Equator, exceeds not *ſix* or *ſeven Foot* Height; yet the vaſt *Extent* of its *Compaſs*, kes it *equivalent* in Breadth; and able to ch up the greateſt Floods: For Example, oſe at St. *Malos*, and *Briſtol*: Whereas at *Virde*, and the Oppoſite *Weſt-Indian Iſlands*, ich lie under the *Tropick*, at 25 *Degrees* of titude, which is their *Common Axe*; the ſame Tides, in paſſing it To and Fro, ſcar make *any Appearance* at all; or even a *ſenſi* *Variation* of High and Low-water in t Ocean.

And to paſs on to the *Ethiopick ſide* of t *Line*, we preſently meet with a *fierce* and *v* *lent* Flood, in the Chops of the *Streight*, b tween the Coaſts of *Guinea* in *Africk*, and *Br* *ſile* in *America*; which, being *contracted* on bo Sides, by their *Inclining* Shores, even force Ships from their Anchors: And at the O *End* of that Flood's *Libration*, the Tide ru as high from *Rio de la Plato*, and *Terra del Fu* that is, from 40 to near 60 *Degrees* of Latitu as it does reſpectively on the Coaſt of *Euro* Whereas at St. *Helen's Iſle*, which intervenes the *Axe of its Libration*, and lies at the ſa Latitude with *C. Virde*, on the Oppoſite ſide the *Line*, it ſeldom exceeds a *Foot*; as is fou by Obſervation.

And, to turn over to the Backſide of *Peru*, are often told of the high Floods which N *vigators* meet with in the *Pacifick Sea*, that into the *Weſt-End* of the *Magellanick Strei* about 50 *Degrees* South Latitude: And aga we hear of the like in the *Gulph of Pana* which lies within *three Degrees* of the *E* *noctial Line*; without the leaſt mention of a Tide near the *Tropick*, that is Remarkable.

Finally, As to the ſaid *Libration* in the *E* *Indian Ocean* (which lies *ſhut up* towards *North*), the *Flux* of the Tide, upon the Moo *Approach* towards the *Meridian*, is conſtan driven *Sea-ward* by her Preſſure; as plai appears, by the *overhaſty* Return of its *Re* back again from the *South*, upon her Decli

c

on into the *Weſt* ; not only to ſupply the *Va-*
ity, left by her Abſence ; but withal to fetch
p Two of the *greateſt Tides* that are known
thoſe Parts, and Both in the *Torrid Zone* ;
e One near the *Mouth of Indus*, and the O-
er of *Ganges* ; to the Wonder and *Aſtoniſh-*
ent of the *Inhabitants* thereabouts: So mani-
ſt it is, that *Low-water* ſtill attends her *Pre-*
nce and *Preſſure, between the Tropicks* ; and High-
ater *Souths* as conſtantly with Her, *beyond 'em* ;
d that Each *ſucceeds* the Other in both Pla-
s, by an *alternate* Reciprocation.

Such are the Revolutions of the Tides in
oſe *Four* Chief Diviſions of the *Ocean*, and
manifeſtly they are perform'd by *Libration* ;
ith repeated *To's* and *Fro's* from the Middle
the *Torrid Zone*, down as far into the *Tem-*
rate Ones, and back again ; as plainly appears
the Inſtances already produc'd for that pur-
ſe: Yet, foraſmuch as thoſe Tidal Tumours,
either hang *pendulous* in the Air ; nor librate
p and Down therein upon an *Axe*, which pro-
erly ſuſtains 'em ; but *Raiſe* and *let Fall* each
ther, Reciprocally ; by the *Protruſion* and *Sub-*
action of the ſame Portion of Water ; which
llows the *Flood* cloſe to ſupply and ſuſtain
, till the *Ebb* withdraws it again ; and Both
ays by Flux, and Reflux, alternately : Hence
occurs to ſhew, How ſuch Mountainous Bil-
ws are tranſlated *Backward* and *Forward*,
ith *Eaſe* and *Speed*, to ſo vaſt a Diſtance.

SECT. IV.

The Collateral Reſult *of the* Tide's Undulation *from between the* Tropicks *towards the* Poles *in* ſix *Hours* ; *and their* Revolution *back agai* *in* other ſix ; *is ſhewn conformable to Reaſon* *and teſtified by Experience.*

TO derive the *Tide's Undulations* (rais'd b the Dint of the Moon's Preſſure upo the Sea, *between the Tropicks)*, with a regula Courſe of *Reſult* from the *Equator*, into *Nort* and *South* Latitude: It is to be conſider'd, th thoſe Tidal Billows lie naturally extended *Ea* and *West*, from One ſide of the Ocean to th Other ; as being ſo *directed* by her Diurn Courſe, which draws 'em Parallel to the E *quator.*

But withal, her Preſſure being moſt *Inten* where it falls *Perpendicularly* upon the Surfac of the Sea ; and ſhe ſtill holding on h Courſe between the *Tropicks*, or thereabout the ſaid *Undulations* muſt as conſtantly be dr ven *tranſverſly*, from the intervening Impreſſio towards the *Polar Circles*, by way of *Reſult* which, after the ſaid Preſſure is withdraw muſt be devolv'd *back again* towards the *Equ* *tor*, by the Poiſe of their own *Weight*, accor ing to the *ſame Degrees* whereby they we mounted ; the Moon, at their *ſecond* Retur ſtill giving 'em a Counter-jog, to perpetua their Reciprocation.

Now, in regard the Courſe of the Tide, *Navigators* obſerve, runs very High into t *North*, as far as *Davis Streight* ; as alſo to t

Magell

Magellanick Gulph, which lies as far *South*; yet keeps Touch *both ways*, with the Moon's Impulſe, which drives it Thither; it muſt needs perform its To's and Fro's, between the *Equa*-*or* and the *Artick* and *Antartick Circles*, backward nd forward, in *Six Hours* apiece reſpectively; nd Move each way 70 *Degrees* of Latitude, in *ix Hours* Space, at the rate of 230 *Leagues* per *Hour*; which to do near the *Shore*, or in *Shalow* Water, were Impoſſible.

Yet, if we allow the *Expanſion* of the Ocean o be of equal *Breadth* from *Eaſt* to *Weſt*, with s *Length* from the *North* to the *South* (as the *North* Part of the *Atlantick*, for Example, is qually *Broad* from the Coaſt of *Africk*, to the ottom of the Bay of *Mexico*; as 'tis *Long* from he *Tropick of Cancer* to the *Artick Circle*;) The id Motion of the Tide, down the *Midſt* of s Channel, will prove *ſmooth* and *eaſy* enough: or, if its *Area* were divided into *Square Inches*, o One of 'em needed, in all that *Six Hours* pace to depart from its Fellow, either backward r forward, more than *twice its Breadth*, to perrm its reſpective Part of the Revolution; ſo either to make their *Friction* difficult, or eir *Sliding* by each other, even in the *Middle* ream, where their Motion wou'd be *ſwifteſt*, all Perceptible.

Again, To allow the ſaid Part of the *At*-*ntick*, a Profundity of *Depth*, proportionate its Expanſion in *Length*, and *Breadth*; the ater, ſo moved, muſt acquire a correſponnt Volubility *Up* and *Down* to its *To's* and *o's*; and an equal Liberty to *Aſcend*, or *De*-*end*, upon any Commotion, with more Eaſe; cording to the Increaſe of the *Depth*, which is occaſion'd jointly, by its greater Diſtance from the *Shores* on each ſide, and from the *Bottom* of the Ocean ; to Both which, the Water immoveably *Adberes*; ſo as to raiſe the *Higheſt* Flood, and let fall the *Loweſt* Ebb, where the Channel is *Broadeſt*, and *Deepeſt* ; as is manifeſt.

Now, ſeeing the Tide is Cauſed by *Preſſur* the Motion of its Gravitation muſt reach a far, as that part of the Stream, which is ſo depreſs'd, *preponderates* the Dead-Water, which either *oppoſeth*, or *ſurrounds* it ; That is to ſay, t the *Bottom* of the Sea, how Deep ſoever it be before it *Rebound* up again to the ſame Heigh whence it deſcended : *Again*, foraſmuch as is driven *tranſverſly* Both ways, from the *Pe pendicular* ; and deflects on each ſide of the *quator*, alike towards *North* and *South Latitud* it muſt fall upon the *Bottom* of the Sea, *Obliq ly* ; and be Reflected by it, at the *ſame Ang* Upwards, towards its Superficies : So th where the *Point of Repercuſſion* is deepeſt, the mergency of the Tidal Tumour muſt be *f theſt off*; and yet be perform'd alike, in *Six Ho* Space ; and muſt reach its utmoſt Stretch, in Our *North Latitude*, and as far into the *Sou* by the Force of the *ſame* Impulſe, and at t *ſame* Time.

Yet the *Mid-Sea Current* of Water, how luble and far extended ſoever, needs not Move, as to any determin'd Part, perhaps mo than *Ten* or *Twelve Feet*, either Backward Forward; ſince the Ocean is *continuous* throu out its Courſe, and the Tumour rais'd at *One End* of it ſufficeth to ſupply the Depre on, whereby it was rais'd at *the Other* ; and

Fall below the Ocean's Level, to *remount*
here a Tumour equal to itſelf; and ſo they
ir up Each other reciprocally, by a *Counter-*
ration: As the Water in the *One* End of the
phon, upon every Agitation, To and Fro, does
e like in the *Other* End, at the *ſame* Time, by
rtue of their Communication through the
termediate *Tube* which joins 'em, let their
ſtance from Each other be what it will.

Beſides, the *Spherical Curvity* of the Sea's Su-
rficies, and the Obliquity of its *Declination*
om the *Horizontal Plain* of the *Equator*, ſtill
eeting the Courſe of the Aſcending Arm
ore *directly*, the *Angle of Interſection* is render'd
ore *Obtuſe*: Again, its Aſcending Stream be-
g, as it were, *alleviated* by Reflection up-
ards, is Buoy'd up by the Periſtaltick Gravi-
tion of the *ſurrounding* Body of Dead-Water;
hich ſtill Inclines it, by degrees, *towards the*
rpendicular; till at laſt it affects the *ſupertending*
ch of the Ocean's Surface, at *equal Angles* on
ery ſide; and raiſeth a Protuberance upon
, without the *leaſt determination* to any One
rt, more than the Reſt: As the *Mariner* well
ſerves, who finds no Tide in the *Middle of*
e Ocean, to obſtruct the Courſe of his *Ship*, or
ive It one jot from its true Longitude, or
atitude.

Nor needs the *Navigator* to complain, that
e ſaid Protuberance is any *hindrance* to his
hip's way, while he ſurmounts it; which ri-
th not *one Foot* in a *hundred Leagues*; any more
an a *Traveller* can repine at the *Unevenneſs* of
s Journey, from *Edinburgh* to *London*, in caſe
e *Oblateneſs* of the Earth's Globe raiſeth the
tuation of the *Latter*, at leaſt a Fathom higher

than the *Former*; Nor ought to diſcredit hi
Own Obſervation, as taken from a falſe or *un*
certain Level of the Sea, upon its *Tidal Tu*
mour, or *Detumeſcency*: A difference too *ſma*
and *nice*, to be diſcern'd by the Bluntneſs o
Senſe, or diſcover'd by the Shortneſs of his *In*
ſtruments.

So conformable is the *Reſult* of the Tide
Undulations from the *Equator* towards the *Pol*
and their *Revolution* back again, both to th
Laws of Motion, and *Teſtimony* of Experience
as well in the *Pacifick Ocean*, as in the *Atlantick*
Both which *lie Open* to the utmoſt *North* an
South, without any Impediment; and no le
in the *Indian* too, tho' it be quite *ſhut up* to
wards the *North*: In All which, as I hav
ſhewn in the *Laſt Section*, the Tides run ver
High in the *Torrid Zone*; and in *This*, that the
mount to an equal or equivalent Height i
the *Temperate*, as being the *Counterpoiſe* to Eac
other.

Yet, becauſe the ſaid *Extremes* muſt adm
of a *Mean* between 'em, to be the *Axe* of the
Libration; Hence it is farther obſerv'd, Tha
whereas the Tide, on each ſide of the *Equat*
for the Space of about *twenty Degrees* on eith
hand, bears up to conſiderable Height; an
from *forty Degrees* to *ſixty*, reacheth the ſam
Height, as being its *Counterpoiſe*: Yet, betwe
twenty and *forty Degrees*, which is the *Axe*
their *Libration*, it grows ſcarce Perceptible; t
Tide being upon a conſtant *Decay*, from t
Streight of Gibraltar, till it *revives* again at t
Tropick; and continues its *Increaſe* till it rea
the *Equator*: But, from the Latitude of *ſi*
Degrees, towards the *Poles*, as being the *full* P

of its Courſe, on that ſide, it *Languiſheth* a-
y of its own Accord, inſenſibly to almoſt
thing ; every *Libration* conſiſting of *ſix*
rs, and their *Reciprocation* of as many.

SECT. V.

the Circular Diffuſion *of the* Tide, *from the* Center *of its Tumour, in Our* North Atlan-ick Ocean, *to its* Eaſtern *and* Weſtern *Shores*; *As alſo towards the* Tropick of Cancer, *and he* Artick Circle.

HAving already drawn the Courſe of the
Tide, from the Moon's *Depreſſion* of the
upon the *Equator* ; and rais'd its Tumour
r the Middle of Our *North Atlantick* Sea, by
ration: Now, to enforce its Flood by its
umeſcency , *Circularly*, towards all the
nts of the Compaſs at once, by way of *Un-*
tion ; No more is required, than what con-
tly happens, upon the Fall of a *Stone* into
ool of Standing-Water ; which preſently
deth forth *Circular Undulations*, after the
e Manner: But, before we proceed to de-
be it,

t is to be *Noted*, That the *Center* of the ſaid
mour, cannot be affix'd, with a *Geometrical*
ctneſs, to any *Point* or *Degree* of Longitude
Latitude, till the *Depth* of the Sea (whereon
Angles of *Incidence* and *Reflection* depend) be
recifely known, as either the *Length*, or
dth thereof ; Nor can the *Space* of Sea af-
ed by it, be confin'd in a ſtrict Senſe, to
any

any *determinate* Compaſs upon its Superficies as being effected by *too blunt* an Inſtrument, the Moon's Preſſure is; Eſpecially upon *bulky* a Body, as our *Globe* of Earth and Se conjoin'd; but muſt needs *ſpread* it ſelf to vaſt Extent, without any other Transfuſio than its own proper Magnitude.

Beſides, Our *North* Part of the *Atlantic* whereon this Tumour is rais'd, being of Regular *Rectilinear Figure*; neither *Triangul* (which it moſt repreſents), nor a *Polygone* any determinate Sort; and That Tumou which ought after a ſpecial manner to reſem ble It, conſiſting of *Water*, which muſt *Curvilinearly* circumſcribed, and yet be neith *Circular*, nor of any of the *Conick-Sections*; cannot admit of *any Center*, in the ſtric Senſe: Yet, becauſe the *Lines* of its Diffuſio muſt needs reſpect ſome *One Place*, more th the Reſt; It will not be amiſs, for *Illuſtrati* ſake, to aſſign ſome *One* Place, which m ſeem more proper than any *Other*; and how It will hit with *Experience* and *Obſer* *tion*.

To aſſign the Point, as a *Center*, when That *Diffuſion* of the Tide proceeds; it ſee moſt Congruous, to fix It upon the *Great* *ridian*; (I mean That, whereby *Geographers* criminate the Two *Hemiſpheres* of the *Old* *New* World, Each from Other), which ſee to divide Our *North Atlantick*, with moſt quality, into *Eaſt* and *Weſt* Parts: And wh it is Interſected, by the *Parallel* of *Forty* *Degrees* of the ſame Latitude, as a *Mean* tween the *Artick Pole*, and the *Equator*: N to Evince at once, the Exiſtence of ſuc

Tum

our, whence the ſaid *Diffuſion* is Actually de; and that its *Center* is aſſign'd aright, n the *Setting* of the Tide every way *Out-d* from it, without any reſpect, or regard; oduce the *following Inſtances*, for Examples; d it is a *generally receiv'd* Opinion, and built n common Obſervation; That, *the Tide ſets, the Middle of all free and open Seas, directly ards their Shores.*

ow, to point out, in ſome meaſure, the *ter* of its Transfuſion in the *Atlantick*; It ,upon *all the Coaſts of Europe*,out of the *Weſt*: d to ſhew that it is not *afar off*, it arrives, the *Weſt Coaſt of Ireland*, as being the *Fore-* of all *Europe*, at ſcarce *three Hours* after the *n's Southing*, upon *That Meridian*; as it does n after, upon all the moſt *Weſtern Coaſts* of *nce*, *Spain*, and *Portugal*, which lie near the *e Meridian*; without any regard to their *erent Longitudes*: All which lie at near an *l diſtance* from the *Point* aforeſaid, and make gh-water at the *ſame Time*; allowing only e *few Minutes*, to adjuſt the Computation, proportion to the *Inequality* of their Shores.

gain, The Courſe of the Tide as little re-ds the *Longitude* of the Places which it af-s, whether they lie *Eaſt* or *Weſt*; Provided y lie at an *equal* diſtance from the ſaid *Me-an*; and have an *Open Sea* between 'em: nce the ſame Tide makes, at once, High-ter on the *Coaſt* of *New England*, in *America*, d on that of *Poitou* in *France*, and much af-the ſame Manner; As a *French* Writer re-ts it did, on *July* 16th, 1670, when there ppen'd an Extraordinary New Moon-Tide, the *Mouth* of the River *Pentequit*, in *New-England*,

England, at *Eleven and a quarter* in the *Mor* *ing* ; and at *Rochel* in *France*, about *Thre* *an half* in the *Afternoon* ; their Coaſts, lying *ſeventy Degrees* diſtance ; which adjuſts Tide almoſt to the *ſame Inſtant*, in both Places without any regard to the Diverſity, of the *Eaſt* and *Weſt Longitudes* , (the ſame Tide ſe ting *both Ways* at once ;) or the leaſt Notic taken of the Moon's *Abſence* from both *Me* *dians*.

And as to the *flooding* of the Tide, direct towards *North* and *South* ; ſeeing the *E* which happens between the *Tropick of Can* and the *Equator*, in the *South* ; and the *Flo* which we here deſcribe, ſwells up as its Cou poiſe, between the ſaid *Tropick*, and our *Po* *Circle*, in the *North* ; it cannot terminate in *Inſtant* ; but they muſt be *gradually* diſcrimin ted, each from the other , by a vaſt Space the Ocean ; which muſt be at once affecte by all poſſible *Diverſity* of *Heights* of Wate *reciprocally* : Hence that Interval muſt be b holden to the *progreſſive Diffuſion* of the afo ſaid Tumour ; to furniſh it with a correſpo dent Tide, *ſetting into the South*, to what I ha deſcribed, which flows towards the *Eaſt* a *Weſt*.

Whence it comes to paſs, that at the *Iſl* *of Teneriff*, which is the utmoſt *Weſtward* of *Canaries*, and lies upon the *firſt Meridian* ; not High-water, till the *Third Hour* after Moon's Departure from it ; becauſe it lies an *equal* Diſtance, from the *ſame* Ebullition the Tide, with the *Weſtern Coaſts* of *Sp* *Portugal*, &c. where it *ſets* as aforeſaid : A it *ſets* out of the *North*, into the *South* , to

mo

nſtrate its Origin to be the ſame with theirs,
ich *ſet* from thence to the *Eaſt*, and *Weſt-*
d; and ſo *ſets all Three* Ways at once, as is
nifeſt. And, by Parity of Reaſon,

e muſt conclude, That the Tide *ſets* like-
from the *ſame Center* of its Diffuſion, in-
he *North* : as the *Dutch* find by Experience,
o *ſail back* from their Northern Fiſhing
er by a Fortnight's Time, than they did
her. And all *Navigators* Atteſt, that the
er ſwells in *Forby's Paſſage* at VI; in *Da-*
Streight at VII $\frac{1}{2}$; and in *Baffin's Bay* at X;
greſſively towards the *North*, and in Spaces
Time, *proportion'd* to the Tracts of Sea
ch it paſſeth over, from the *Center* of its
eſaid Diffuſion, to within *fifteen Degrees* of
Pole it ſelf.

ence it is as manifeſt, that That Diffuſion
the Tide, ſpreads itſelf *circularly*, from
Middle of the *Atlantick*; as that the *Sun's*
flow from his reſplendent Orb; And the
er of its Intumeſcency is as plainly re-
k'd, by its *ſetting outward* every Way from
as the Center of the *Sun* is, by the like
ſion of his Rays towards their Circum-
nce.

SECT. VI.

How the Tide is ſpread over the Atlantick Oce *and communicates it ſelf, to* Other Seas, & *And by its alternate Floods, and Ebbs, ma ſtill a* Reſtitution, *correſpondent to the Div ſity of its Motion.*

TO *devolve* the tidal Tumour, raiſ'd by t *Laſt Section*, in the Center of the *lantick*, to all its ſurrounding *Shores*; no m is required at preſent, than to let it ſink do again, in the *ſame Place*, where it aroſ Thereby to ſwell up, *circularly*, its *Counterp* of Water, as far as the Compaſs of that O an can afford *Depth*, and *Breadth*, for its lows to *ſwell*, and *rowl* in full Meaſure: T ſaid Tumour being, of its own Nature, eve Way *apply'd* alike; and the Sea equally *pos'd*, on all Sides, to receive the Effect of *Undulation*.

Firſt, This circular Transfuſion of the Ti expatiates it ſelf fartheſt, in the ſhorteſt Ti towards the *North*, (where the Ocean is of *largeſt Extent*); meeting with no occurri *Shore*, or *Shallow*, to countermand it b again: And it Falls *by Degrees*, till the Ene of the Tumour's Impulſe, which firſt ſet it Foot, be quite ſpent, by ſo long a Cour As a *Stone*, caſt into a *Pool* of ſtanding Wat ſpreads its Undulations *circularly*; and lets fall ſtill *lower* and *lower*, till the Commoti languiſhing away by its *Expanſion*, ceaſeth.

Secondly, As to the Tide's Tranſuſion to-
ards *Eaſt*, or *Weſt*, where (the Ocean being
arrower; the Shore *ſooner* occurs to the
reading Billow) upon its approach to the
undings, it preſently ſtirs up its Flux that
ay: And being ſtraitned by the ſhallower
ottoms, into a *leſs Compaſs*, muſt ſeem to
ake *more haſte* forward: As a River rūns
ooth and *ſlow*, while it continues *wide* and
ep; but grows *ſwifter* upon its *reſtraint*, in
ther Reſpect: And where it finds a *Creek*,
Inlet into the Land, it drives a *ſtronger Cur-
t*, thither-ward: And if the *Mouth* of the
iver, which receives it, be wider *Sea-ward*,
d grow *contracted* afterwards, ſtill its Speed
increaſed, in the ſame Proportion.

Now, becauſe Salt-Water, whereof this
ogreſſive Tumour conſiſts, is of a *voluble*
d *heavy* Nature; it moves eaſily, after it is
ce ſet on Foot: And requires a proportio-
te Force, to *ſtop* its Career: And withal,
ing of too cloſe and compact a Texture to
compreſs'd; That Part of it which is actu-
ly mov'd, muſt ſtill *puſh on*, that which goes
fore it, forward; ſo as to *ſwell* the Ebbing-
ater, which occurs, into a Tumour, by *Anti-
pation*; before the Flux of the *Flood it ſelf*,
its own proper Courſe, can poſſibly reach
: As a Pole, being thruſt *forward* at the one
nd but *an Inch*, drives on the Motion of its
hole Length, at the *ſame* Inſtant, to the o-
er, tho' it be at leaſt *Ell-long*: So may the
umour of the Tide paſs on *a League*, while
determinate Part of its Flood reaches above
Furlong.

Hence it is, that our *Engliſh Channel*, havin an *open* Mouth towards the Sea, receives i Flood *freely*; and having a proportionab *Depth*, lets its Tumour rowl forward, with great deal of Eaſe; and *contracting* it ſelf a terwards in both Reſpects, keeps it up at lea to the *ſame* Speed, till it reacheth the *Streight*, b tween *Dover* and *Calais*; where it returns up th *Thames*, with ſome Abatemant: But to th Sea-ward of *Holland* and *Denmark*, ſoon *fa away* to Nothing, by its greater Expanſion Thus every ſingle Tide, as it was rais'd orig nally by *Protruſion*, ſo it is ſtill carried forwar by the *projective* Dint of its firſt Impulſe, fro the Moon's *Depreſſion* of the Ocean near th *Equator*, all along the *Atlantick* up into th *Rivers*, where it expires.

Such is the *progreſſive* Flux of the Tide, fro the firſt Depreſſion of the Sea upon the *Equ tor*, to its reſult at the *Center* of the *Atlantic* and it is thence convey'd thro' the *Narr Seas*, up into the *Rivers*, till its final Reſolu on into *Calm-Water*: Now, in regard the fi Tumour, was not only refunded back in that *Depreſſion* which firſt rais'd it, by way *Reſtitution*, and fill'd up that *Vacancy*; but a *remounted* it again to its own Height, by *Co ter-Libration*; the like muſt be done to the ſ Tumour, by the *circular* Billow, which *ſ rounded* it; and, by Parity of Reaſon, t *whole Progreſs* of the tidal Flux thro' thoſe S and *Rivers*, requires a continual *Regreſs* a *Reflux* of the like Nature, in all Places.

And, ſince the Moon ſets on her Preſſ at the *Equator*, and takes it off again, *peri cally*, at every *ſix Hours* end; and correſp

ntly raiſeth the *Atlantick* Tumour, and lets
fall again *as often* : The *ſecondary* Billow,
ich is rais'd *around* it, muſt conſequently
and *fall* reciprocally, by *counter-Libration* ;
receive and *return* its Quota's of Flood and
b, on *all Sides* of its Circle, at *once* reſpe-
vely, to make an alternate *Reſtitution* in the
cean : So muſt alſo the Floods and Ebbs, of
ry dependant *Sea*, and *River*, become *re-*
ocal, and hit exactly the *ſame* Periods ; as
ring *every where* the double Stamp of their
Commotion, impreſs'd upon 'em at tho
uator.

And, foraſmuch as the Flood was rais'd at
t by the Moon's *Protruſive* Peſſure ; and the
bing-Water was let fall *back again*, alternate-
by its own *Gravitation*, to fill up and ſur-
unt the *Vacuity* left on the *Equator* ; They
l retain *every where*, the *ſame* Reciprocation ;
Flood, by *increaſing* progreſſively the Ti-
Tumour *before* it, by its *protractive Addition* ;
the Ebb, by *withdrawing* as much Water
ind it, by its *Gravitation* ; leaving the Tu-
ur higheſt in *the Middle*, to maintain its
greſſive Impulſe, forward ; while a *Sub-*
ction is made on the *one* Part, of what is
ed on the *other*, to make a through-out *Re-*
tion, with regard to the common Level of
Ocean.

To make ſo *general* a Reſtitution with *Eaſe*
Expedition ; it is to be conſidered, That al-
ugh (for Example) the Flood which arrives
London-Bridge was rais'd the *Day before*, by the
preſſion of the Sea at the *Equator* ; yet ano-
r Tide *intervenes* in the mean Time, between
ſe two Places, and happens *every where* alike

at *Twelve Hours* end, to ſupply the *Middle* S
tions; and one Flood ſtill ſucceeds another
the *ſame* diſtance of Time; as alſo an Ebb a
ways intervenes between *every Two* Flood
Hence their *whole Courſe* of Ebbs and Floo
naturally divides it ſelf into *four Stages*, th
which they paſs with an *alternate* Succeſſio
but with a *different* Speed, and after a diver
Manner.

They run their *firſt Stage* from the *Equa*
to the *Center* of our *Atlantick* in *Six Hours* ſpac
at the Rate of *five Hundred Leagues per H*
(by way of *Libration*); and make their reſpecti
Returns in as many: The *ſecond Stage*, from t
ſaid *Center* into the Chops of *our Channel*, in S
alſo, at the Rate of about *one Hundred Leag*
per Hour, (by *Undulation*:) The *Third* from th
entrance into *our Channel*, to the *Streight* betwe
Dover and *Calais*, (by *Fluctuation*,) only F
Leagues per Hour: And their *Laſt* from t
Streight up the River of *Thames* (by a *protruſ*
Fluxion,) no more than *Ten*: And the Hi
they go, the *leſs haſte* they make to the final
riod of their Courſe; till at laſt their Pace gro
ing *ſo ſlow*, and their *Six Hours Allowance*
their Interchange continuing ſtill *the ſame*;
Tides come up *ſo cloſe*, one on the back of a
ther, that *Two* are ſometimes found at o
within the *ſame River*: Thus, by a *perpe*
Reciprocation, every Flood having its ſucceed
Ebb to devolve it back again; each ſupply
its proportionate Part, in *due Order*; the Per
mance is every where *at once* render'd compl

Laſtly, Concerning the Diffuſion of th
boveſaid Tumour into the *South*; as much
as tends directly towards *that* Point is ſoon

o a Stop by the *Axe* of its *Libration* : But upon
ts Declination *to the Weſtward*, towards the *Ca-*
ibee and *Antilla Iſlands*, this *ſecondary* Tide lan-
uiſheth away almoſt into Calm-Water before
t reacheth the *Primary* Flood, at ſo remote a
iſtance from the *Center* of its Diffuſion: Whereas
the Eaſtward, the Flood falling upon the Coaſt
f *Africk* (which is not *ſo far* off) too obliquely
o be repuls'd towards the *Northweſt* Tumour,
hence it came ; it is deflected into the *South*,
nd becomes a *Coaſting Current* towards the *Equa-*
r : And ſuch like *Currents* attend the Shores of
e *Indian*, *Ethiopick*, and *Pacifick Oceans* ; and
oubtleſs, they proceed from *the like* Tumors :
o that, having already diſcover'd their com-
on *Origin*, let us ſee how they are propaga-
d, in the *following Section*.

SECT. VII.

w it comes to paſs, that the Coaſting Currents
of the Ocean, which riſe beyond the Tropicks,
conſtantly tend towards the Equator.

HUS the Tide paſſeth from the *Equator*,
beyond the *Tropicks*, and repaſſeth back
in in the *Midſt* of the Ocean in *Six Hours*
ece, by an alternate *Libration* ; where it has
liberty to ſwell, and rowl at a greater Rate :
what correſpondent Returns of Floods and
bs the *Coaſting Currents*, which proceed from
can make, by a *ſlow* Progreſſive Pace, up-
their *ſhallow* and *narrow* Bottoms, is to be
her accounted for ; and their Courſes are,
due proportion, to be *adjuſted* to each other,

that every Flux may have its Reflux on eith part, of the ſame Kind, or elſe ſome *Equiva lent*, whereby to make the Ocean's *Equilibri* by Reſtitution.

Now, in regard the Flux of theſe *Coaſti Streams*, ſtill deſcends from a Higher to lower Situation; they muſt continually ali *withdraw* themſelves from the *Flowing* towar the *Ebbing*-Water; as long as the Sea's Expa ſion, *betwixt* thoſe Streams, is continued to equal Breadth; and each Two *counterpoiſ Currents* (in compliance with the Floods a Ebbs, from whence they ſpring) muſt alterna ly riſe *higheſt* and fall *loweſt* at the ſaid reſp ctive *Ends* of their *Libration*; but ſo (by rea of their *ſlow* Pace) as neither to raiſe nor fall the *Axe* of their *Mean Courſe*, from the *vel* of the Ocean: Their Fluxes and Reflu *decaying gradually* into Calm Water, before th reach it; or elſe mutually ſo to affect e other, as to incline it *towards neither* Part.

But in caſe the *Gulphs*, on each Side whe of there is an *Intercourſe* of thoſe counterpoi Streams, be *wider* at the one End than at other; thoſe Two Currents which proceed fr the *greater* Expanſion, being *contracted* by *inclining Shores*, on both Sides, muſt bec more and more enliven'd, to flow *Faſter*, hold out *longer* than thoſe *other* on the Coun part; which, being as much *dilated*, bec proportionably *weaker*, and conſequently *able* to countermand 'em back again. I much, that

1. The *Coaſting* Streams of the *Ethiopick an*, by receiving quicker Recruits of Wat the *South* (where the Sea is more *dilated*) by

bra

tion from the Flux of the Tide thitherward,
hich is perform'd in *Six Hours*; than can poſ-
ly be return'd by their *ſlow* Progreſſive Re-
x towards the *Equator*, where it is moſt *con-*
ed; beſides, ſharp'ning their *Force* ſtill more
d more by their Contraction; they *repel*
Counter-coaſting Streams, which otherwiſe
d occurr'd and met 'em the half way; and
come, on both Accounts, *perpetual* without
Reciprocation.

And, foraſmuch as the Tidal *Libration* is
efly cauſed by the *Meridional Impulſe* of the
on's Preſſure, *driving* it directly towards
Poles, by her Preſence; and *letting it fall*
k again perpendicularly, upon the *Equator*,
er Abſence; the Motion of the ſaid *Coaſting*
ams as depending thereon, muſt ſo ſtrictly
erve the ſame Courſe; that, upon any *De-*
ion from the true *North* and *South*, cauſed by
Obliquity of their Shores, they muſt ſtill be
pen'd into *quicker* Currents, on the inclin-
Sides; whether they be driven towards the
t or *Weſt*, or happen in *North* or *South La-*
de, without exception.

. Hence we find, that the Coaſting Current
our *North Atlantick*, tends as directly *South-*
d towards the *Equator*, from the Streight of
altar, along the Coaſt of *Gualata*, to *Cape*
co, as the *Weſterly* Inclination of the adja-
t *African Shore* will permit; and keeps the
umbent *Trade-Wind* ſo cloſe to the ſame
berly Direction, as not to ſuffer it to exceed
nty-Eight Degrees to the *Norward*, tho' its
l Limit be *Thirty* Degrees at leaſt; and be-
repuls'd by the *Shore of Guiana*, it enlarg-
it ſelf again to *Thirty Two* or *Thirty Three*:

Which plainly demonſtrates, that both the Se
and *Wind* are driven *athwart* their proper Courſe
or elſe the Flux of the *Former* had run tru
South; and the *Latter* had neither begun ſo nea
the *Equator*, nor had ended ſo far from it.

3. And to paſs the *Line*, from the *Atlanti*
to the *Ethiopick Ocean*, which lies extended P
ramidically, with its *Vertex* pointing into th
North towards the *Equator*; and its *Baſis* ſu
tending it on the *South*, from the *Cape of Go*
Hope as far as the *Magellanick Streight*; when
the *Collateral* Currents (which at firſt move b
ſlowly thro' that vaſt Extent), being contract
by the *inclining Shores*, mend their Pace (eſpe
ally on the *American* Side, where the Shore
more inclined to the *Eaſtward*) up to the *Eq*
tor; and thence they paſs *Two Degrees* farth
till the Tidal Tumour out of the *North* co
up to countermand them; and then their u
ted Stream veres about *gradually*, from *Weſ*
Eaſt, and carries the *Trade-Wind* headlong w
it, quite contrary to its Common Courſe,
Five Hundred Leagues together.

4. And when we double the ſaid *Cape*, to
Eaſtward of the *African Coaſt*, we meet wi
Current, which follows the Direction of
Shore, from *Madagaſcar*, *North-Eaſterly*, bey
the *Line*, into the *Arabian Gulph*, which c
ducts the *Southweſt-Monſoon* thither; and b
deflected by the *Cambaian* Shore, turns
Northweſt-Monſoon, according to its Decli
on, *back* with it, into the more *Eaſterly*
of the *Indian Ocean*: And to the *Eaſtwar*
China, and *Cambodia*, we find the *North*
South Floods haſting, from the *Pacifick* an
dian-Oceans, towards their Concourſe at
Equator.

5. Fin

5. Finally, on the *Weſtern-Shore* of *Peru*, a
rpetual Flux of Stream follows the *Shore*, from
yond the *South Tropick* as far as the *Gulph of*
nama, up to the *Line* : (As alſo along the
oaſt of *Africk*, from the *Cape of Good Hope* to
e *South* Shore of *Guinea*) for near a *Thouſand*
agues together: And, on the contrary, the
e Flux of Water haſts to *meet* it there from
e *North* at the ſame Rate, tho' with an *une-*
l declivity of the Shores; the *Wind* attend-
g 'em reſpectively, upon the *ſame* Points;
ich plainly ſhews, that the true *North* and
th Points were chiefly aim'd at by 'em both;
d had been as ſtrictly obſerv'd, had the *pro-*
ſion of their *Shores* prov'd more favourable
heir Natural Inclination.

o general is the *Confluence* of all the *Coaſting*
rents of the Ocean, from all Sides towards
Line; and ſo *irreſiſtible* are their Courſes
herward, eſpecially when their Channels
w more *contracted* that way: And to make
eneral a *Reſtitution* to thoſe Seas, no more
equired to keep their *circular Correſpondence*
foot, than that, upon their arrival thither,
y be ingulphed and *ſwallowed down* by the
umeſcency of the Common Tide; and be *caſt*
gain by its *Intumeſcency*, beyond the *Tropicks*
ence they came; that their Fluxes and Re-
es may be perpetually repeated, by an *Al-*
ate Reciprocation, for ever.

§.

ow, leſt it may ſeem impoſſible, for the
e to *ſwell up* Tumours upon the Ocean's
erficies, ſo *high*, as to let Streams *fall down*

from 'em, with a conſtant Deſcent, for Si *Seven*, or *Eight Hundred Leagues* together; an ſuch as are the *Currents* which do Coaſt Gu *lata*, and *Congo* in *Africk*; and *Peru* in *America* Or elſe, leſt it ſhou'd appear no leſs practicabl for any poſſible *Impulſe* of the Sea to *drive* th ſaid Stream progreſſively for ſo long a *Courſe* upon the *ſame* Level with their adjacent *Ocean* (which remain *Calm* and *Stagnant* all the while eſpecially, their Channels being too *Shallo* and *Narrow*, for their Floods to be accelerate by *Undulation* or *Libration*; as is manifeſt:

To clear theſe Doubts, it is *remarkable*; th (all thoſe *Three Coaſts* lying open to the Ocea towards the *Weſt*) the *Trade Wind* very oppo tunely ſupplies all thoſe Defects, by *deſcendin* down upon thoſe Rills underneath, from the reſpective *Eaſtern Shores*; which, by unitin its Streams of *Air*, with theirs of the *Wate* gives 'em *Fall* all along thoſe Coaſts; eſpec ally the Wind moving alſo towards the *Equato* where the Air is lighter, and more *expanded* receive it.

And, as for thoſe *Currents* that Coaſt t *oppoſite Shores*, which the *Trade-Wind* confro on the *Eaſt* of *Braſile* and *Ethiopia*, after it ha gather'd more Force in paſſing over the *E* *Indian* and *Weſt-Indian Oceans*; it is again *rem* *kable*, that it diſputes *every League* of the R turn of thoſe Coaſting Streams, towards t *Equator*; and according to the ſeveral Seaſo of the *Year*, takes their Advantage againſt ea other's Courſes, as well in the *South Atlanti* as the *Eaſt-Indian* Seas, while it blows on t *South* Side of the *Line* more *Eaſterly*, and the *North* Side more *Weſterly*; but never to t

degr

gree, as to put an abſolute Stop to that of
Sea underneath, towards the *Equator*.

And, if it appear leſs conſiſtent with the
ws of Motion,than is practicable ; that theſe
plies from the Tide ſhou'd be *Periodical*, and
etimes *Intermit* ; yet the dependent *Coaſting*
rents flow Progreſſively the *ſame* way, to a
petuity : 'Tis no more than what conſtantly
pens in the Flux of the *Veins*, in reſpect of
Arteries, in the *Bodies* of *Animals* ; and leſs
e wonder'd at in theſe Currents of the *Sea*,
ere freſh *Recruits* come in *Six-Hourly*, on the
Part ; and the Courſe which *evacuates* 'em
the other, reaches not its Period, with re-
d to any *determinate Part* of the Water which
mov'd, perhaps once in a Month.

uch is the Tendence of theſe ſcatter'd
ams, in the *Ethiopick*, *Indian*, and *Pacifick*
ns ; and ſo conformable to thoſe, which
found in *our North Atlantick* ; as to inferr a
'-out *Analogy* in the Production, and Pro-
ation of the Tide itſelf in *all Places* ; ſo
at leaſt, as each of 'em to *ſwell up* a diſtinct
mour, about *Forty-five Degrees* on each Side
he *Equator* ; and to *diffuſe* their Effluviums
r the *ſame* manner, into *all Seas* and *Rivers*
'-out the Univerſe : Let us ſee how the
n Bodies of the *Ethiopick* and *Atlantick* Floods
ſt each other, at their *joint Return* to the
ator ; to draw the *Theory* of this Deduction,
a farther *Obſervation* of Matter of Fact.

SECT.

SECT. VIII.

Of the Concourſe, *and* Reſult *of the* Ethiopick *and* Atlantick *Tides, at the* Equator ; *and th* Irregularities *which attend 'em in the Streig* *between* Braſile *and* Guinea, *Explain'd, and Re* *concil'd.*

TO ſhut up my precedent Diſcourſe of th Motions of the *Tide* and *Wind*, as they fa preciſely within the Precincts of the *Ocean*: An as the Former takes its Riſe from the *Moon's Pr* *ſure*, chiefly upon the *Equator* ; and reboun *back again* Thither from the *Poles*, in *ſix Hours* piece ; It remains to determine *When*, and *Ho* thoſe *Tides*, and *Winds*, which are *peculiar* the aforeſaid *Oceans*, ſeverally affect that *Lin* together with their reſpective *Conſequence* which are as follow.

Firſt, Concerning the *Tide*, it is to be Co ſider'd ; That the *ſaid Oceans*, conſiſting of T vaſt Bodies of Water, and lying Situate in *d* *ferent Longitudes* ; the Regulation of their ſpective Tides, muſt be taken from their *M* *Sea Tracts*, where they Move with moſt Fr dom, and ſtrictly obſerve the Courſe of *Moon*, whereon they depend : And, by con quence, They cannot fall upon the *Equa* at the Interſection of any *One determinate M* *dian*, nor be Regulated by it ; but Each ceſſarily requires a *diſtinct* One, according their *different Longitudes* ; as is Manifeſt.

Beſides, That part of the Ocean, which *more Eaſterly*, muſt needs be ſo much *ſooner* fluenced, by the Diurnal Courſe of the Mo

d its reſpective Tide, muſt *precede* the Other
portionably: Hence the *Ethiopick* Part,
ich lies more *Eaſterly* than the *Atlantick*, by
r *thirty Degrees*, muſt Flood about *two Hours*
ner, upon the *Equator*; and finding *Low-*
er There, muſt paſs beyond it to the *Nor-*
d, all the while; until the *Atlantick* Tide
nes up, to *Countermand* It; after it has tranſ-
ſs'd the *Line*, its proper Limit, at leaſt *four*
ive Degrees; as is found by Obſervation.

Nor is any other *Parallel Line* aſſignable, for
ir *Oppoſite* Floods, immediately to Inſult each
er; but rather their Counter-flux's muſt
in to *abate*, at a conſiderable *diſtance*, and
dually languiſh into a Calm, before they *ap-*
ch Each other; and jointly *ſtagnate* for a
npaſs of Sea, *proportionate* to their vaſt Ex-
: As Our *North* and *South Tides* do, at their
ngreſs on the Coaſt of *Suffolk*, which they
alm all along into a *Pool*: So do theſe
nter-floods of the *Ocean*, ſtagnate near the
into Calm-water, as *Hydrographers* remark,
n *four* to *ten Degrees* North Latitude; with-
Aſſigning for it, either This, or any Other
uſe.

Yet the *different Heights* of the ſaid becalm'd
nours, ſo little *correſpond* to the ſeveral *Ex-*
of the Floods, which reſpectively raiſe
; that, whereas Our *North* and *South Chan-*
ſwell *Humber*, at their Congreſs, at leaſt
Fathom; This, which is rais'd by the *Con-*
e of the ſaid *Oceans* (taking the Tide at
n, a Neighbouring Iſle to the *Line*, for its
ndard) Ordinarily exceeds not *ſix Foot*, nor
eradds Extraordinarily above *ſix Inches*; in
rd the *Ethiopick* Flood, having paſs'd thro'
the

the *Streight*, to the *Norward* of the *Equator*, i proper Limit; and *ſpent it ſelf* by its Expanſ on, before their Congreſs; it cannot advanc its Stream higher: And afterwards (by its t *Hours Ebb*, before the *Atlantick* makes High water,) it *takes off* as much from the Flux o that Tide, as it *Advanceth*; and ſo keeps the joint Tumour to the ſame Height, without an perceptible Addition, for *near three Ho* Space.

Moreover, in regard the ſaid Tides, bein *driven Originally* by the Moon's Preſſure, a *qual* Angles from the *Equator*, True *North* an *South*; they ſhou'd have *recurr'd Perpendicul* upon It, at their Congreſs: Yet (thro' the d ferent *Figure*, as well as *Situation* of the ſa *Oceans*,) They occur to Each other very O *liquely*; the *Atlantick* Flood, being deflec *Weſtward* by the *African* Coaſt, from the Streig of *Gibraltar*, as far as *C. Verde*; And the *Ethiopi* being contrary-wiſe devolv'd *from the Braſi* *Shore*, to the *Eaſtward*, with greater Precipi tion, upon the Tumour aforeſaid; which, ing *Eaſtward* from the *Firſt Meridian*, ſ more and more, inclines its Courſe *Eaſter* till at laſt it fetches the South Coaſt of *Gui* which deflects it Thitherward, for *five hun* *Leagues* together.

Secondly, Touching the *Winds*, which company the ſaid *Streams*, neither Matter, Diſpoſition for 'em, can be wanting in Juncture; the *Air*, throughout the *Torrid Z* being extremely *Rarify'd*, by the Heat of Sun's Reflection, below; and *Condens'd* as m by the exceſſive Cold of the Upper Reg above; as plainly appears, by the *frequent*

vio

iolent Falling of *Hurricans*, near the *Equator*;
d that alſo *Perpendicularly*; which are con-
rted into as Violent and impetuous a *Wind*;
nting only an *Horizontal Determination*;
ich They receive *Effectually* from the ſup-
rting Streams of Salt-water; whoſe Cur-
t is *ſwift*, *perpetual*, and of a conſiderable
ent.

Hence the *Trade-wind*, which of Courſe
ws *North-Eaſt* from *C. Verde*, on the *Atlan-*
ſide, and ſhou'd begin *low*, and increaſe
dually: On the contrary, it *preſently* becomes
y Brisk; being *enliven'd* by the Breeze of the
ting Current, underneath; which *deflects* its
rſe, according to the *Inclination* of that
re, a Point or two more *Norwardly*; And
hal, confines it to *Twenty-eight Degrees* of
Latitude, inſtead of allowing it *Thirty* De-
s, its *Uſual* ſtint: But afterwards, leaving
rther off at Sea, lets the Wind *fall again* by
rees, before it reacheth the *Caribees*: Both
ch, obſerving the In's and Out's of the
nean Shore, and following the Conduct of
Norward Tendence, re-advance at laſt to
ty-two, or *Thirty-three* Degrees, as it were
Rebound.

hus the *Trade-Wind*, and the *Sea-Breeze*, ea-
comply with Each other, for a Point or
in a *Calm* and *expanded* Ocean: But, to
contrary, on the *Ethiopick* ſide, where their
's are directly *Oppos'd* to each Other, the
Wind muſt receive a *ſtronger* determinati-
rom the ſubſtrate *Current*; and ſo be in-
d more to the *Eaſtward*, by the *Braſilian*
; and re-enforc'd by that *contracted* Sea,
onſerve and *haſten* their Motion; the Cur-
rent

rent of *Water*, underneath, ſtill drawing
Incumbent *Air*, Forward ; which, as it w
opening a Channel in the Sky, for That of
Upper Region to *ruſh down* after it, Both *jo*
puſh the Stream forward, by their Fall ; B
ſtill *mutually exciting* the other's Motion;
the *Eaſtern* Shore of *Ethiopia* at once pu
ſtop to their joint Career.

Such is the *Concourſe* of the *Ethiopick* and
lantick Floods, both of Wind and Water,
the *Line :* Now, to bring 'em off again by
of *Reſult*, ſo that their Streams may make
ſtitution to the Air's, and Sea's *Equilibrium*,
returning whence they came :

Firſt, As to the *Main Bodies* of theſe T
Counter-Tides ; as their *Intumeſcency*
brought 'em on to their Congreſs, each in
Space of *ſix* Hours ; ſo the *Detumeſcency* of
Floods, ſerves now to *take 'em off* again, B
ward and Forward, in *equal Spaces* of Tim
Counter-Libration ; without making any C
motion in the *Air*, that is Progreſſive. A

Secondly, As for thoſe *By-ſtreams* of W
which iſſue Progreſſively from 'em, and
apt to produce the *like Currents* in the
They mutually propagate *Each other*, and j
ly live, and die together ; as happens in
Stream of *Water*, and *Wind conjoin'd* ; W
taking its Riſe at *C. Verde*, and paſſing
Guiana, to the *Caribee-Iſlands*, conveys T
thence *around* within the *Bay of Mexic*
they diffuſe themſelves again, from the
maan Streights into the *Ocean* ; where th
parate into *diſtinct Currents* of Water, and W
but are ſtill of the ſame *Weſterly* Deter
tion.

And, as for That Stream of *Water*, and Flux *Wind*, which makes ſo much haſte through ſaid *Streight*, from the *Weſt of Braſile*, to the *of Guinea*; As to the *Watry part of it* (find- no other Vent nor Retreat) it ſinks *Sea- d* all the while; and parts with what's ſu- fluous, and exuberant, into the Ebbing le, to carry it off by *Libration*; while the er-incumbent *Wind*, which was denſe and vy before its Fall, goes on *Rarifying* again *Common Air*, by the exceſſive Heat of the ; till it be incorporated with the *South- Trade-wind*, (and ſo 'tis return'd back a- , whence it came); which *never fails* to w, at *two* Degrees on the *South* of the *E- or*; as receiving ſo conſtant a Supply; nor *es* There, as in *Other Seas*, from ſo ſteady termination.

hus are the Concourſe and Reſult, of the *pick* and *Atlantick Tides*, adjuſted; foraſ- h as they conſiſt of *Motion*: But, how Occaſion the Intervening *Calm*, requires farther Explain'd, in the enſuing *Section*.

SECT. IX.

the Calm *in the ſaid* Streight, *is Occaſion'd*; *differs from thoſe, which happen in* other Seas.

Aving already reconcil'd all Appearances of *Irregularity*, in the Motions of Wind ide, which are apprehended to be in the *Streight*, to the *general Rules* already pre- d 'em, by Thoſe who have Treated on

that Subject : It may ſeem vain and ſuperflu
ous, to ſearch after Reaſons for their Oppoſit
Calms ; ſince all Solid Bodies naturally requir
Reſt ; and Fluid ones too as conſtantly pro
pend towards it, all Obſtacles being Remov'

Yet, in regard a due *Examen* of One Con
trary often ſerves to *explain* Another ; and th
reſtleſs Courſes of the *Sun* and *Moon*, draw th
Fluidity of *Air* and *Water*, into an *endleſs D*
ſtraction of contrary Motions ; and theſe v
luble Elements lie ſo *cloſe together*, that the O
can ſcarce be *ſtirr'd*, without *diſquieting* t
Other ; *abſolute Calms* can hardly be found, e
ther by *Sea* or *Land* ; and even Thoſe that a
perceptible to *Senſe*, are not ſo eaſily redu
to their *proper Cauſes*, as not to force Us,
their *Exiſtence*, *Continuance*, and *Extent*,
have recourſe to their different Circumſta
ces.

Concerning thoſe *Calms*, which fall
within the Compaſs of the *Trade-wind* ;
Motion of the *Air* is every-where, both at
and Land, ſo *various* and inconſtant, that
proper Seat, nor Sea, can be Aſſign'd for 'e
And more particularly, the Surface of the
cean is ſo Obnoxious to be *ruffl'd* with ev
Blaſt of Wind, that no *Calm* can hap
There, but by *Accident* ; viz. that *Both* th
Flux's acquieſce *at once* ; which can hardly
farther Accounted for : And, as to Thoſe
happen *between the Tropicks*, they are ſel
found in any *Open* Sea, where there is ei
Flux of Wind, or Water, to *diſturb* their T
quility ; and that moſtly, when the Courſ
the *Sun* is *vertical* ; ſo as to raiſe the Air,
let it fall again *Perpendicularly*, in the ſame P

So that thoſe *Calms*, which fall, as it were,
f courſe, and are *remarkable* for Time, or
Place; ſome are ſhelter'd in the *Bays* and
Creeks, where they happen, by the adjacent
Coaſts, from all Commotions of either kind;
heir *Heights breaking* thoſe Blaſts of Wind,
nd *Forelands carrying off* thoſe Streams of Wa-
er, *Seawards*, from one *Cape* to another,
hich wou'd otherwiſe diſquiet 'em; as it
hanceth in that Elbow of the Sea, on the
oaſt of Peru, where *Calms* and *Hurricans* are
ften found; the *Andes* ſheltering 'em on the
aſt, from the *Trade-wind*; and the *South* and
orth Capes keeping off the *Currents*, which
aſs by the interjacent *Bays* inoffenſively, from
e one End of 'em to the other.

The like Calms, and Hurricans, are found
n the *South-Eaſt* Coaſt of *Africk*, in a *Bay* at
e Entrance of the *Coaſting-Current*, from the
dian Sea into the *Arabian Gulph*; which, ac-
ording to the *South-weſt Direction* of its Chan-
el, paſſeth along thither; while the *Iſle of*
adagaſcar ſhelters it from the Inſults of the
uth-Eaſt Trade-Wind; the like Harbour is
und for 'em, on the *Eaſtern Coaſt of Coro-*
andel, when the *South-Eaſt Monſoon* ceaſeth
diſturb the *Gulph of Bengal*; and a *long*
dge of Hills protects it on the *South-Weſt*
om the Tide, which is warded off all the
hile.

In other Seas, the Tranquility of the Air
ecured from any irregular or haſty Com-
otion of the Tide, by the Conſtipation of
ny Iſlands pitch'd thick together, to hold
eir Superficies *ſteady*; as are thoſe, on the
uth-Eaſt of China; which, being interperſ'd

with the *Philippine* and *Molucca Iſlands*, are infeſted by *Hurricans*, upon the breaking of the *Monſoons* into Calms, as to be ſcar *navigable* : As alſo the *Caribees* in the *We* where the Tides are weak ; when the *Nor* *Eaſt* Trade-wind chancheth to *ceaſe*, or *int* *mit*, are render'd almoſt *uninhabitable*.

Yet ſuch furious *Storms*, which ſeem pe liar to theſe *Iſles*, and ſo dreadfully afflict 'e chiefly in *Auguſt*, when the Sun is *verti* are of no *long* Continuance, or *great* Exte or *Anniverſary* : Some *Years* having no m than *one*, and ſometimes for *ſeveral Years* gether, as Dr. *Halley* remarks, *none* at Whereas the Tract of Sea before-mentio has no Trade-wind, nor a variable ; but ſe to be condemn'd to *perpetual Calms*, atten with terrible *Thunder* and *Lightning* ; and frequent, as to be call'd *The Sea of Rains* ; has neither any ſuch adjoining *Coaſt* to ſhe it ; nor *Iſlands* to ſupport its Quiet, as C require in other Seas.

But, as the joint Concurrence of the E *pick* and *Atlantick Floods* (as I have dem ſtrated in the *laſt Section*) conſpire to that Tract of Water, *fix'd* ; ſo their Co mitant *Currents of Wind*, ſuffice to foreclo other contrary Motions, from annoying Air's Tranquility, for *all* that Space : An extend this Remark to the *Pacifick* alſo, w the *North* and *South* Tides have *Sea-roo* nough, to inſult each other at their O rence upon the *Equator*, all along from to *China*, for *two thouſand Leagues* toget yet they preſerve the ſame Tranquility, of Air, and Water, for *four* or *five* Degre

ch Side the *Line*; notwithſtanding the *Counter-*
proaches of the *South* and *North-Eaſt* Trade-
nds, as *Hydrographers* deſcribe, and *Naviga-*
s find by Experience; who, ſailing *Weſt-*
rd from *Peru* to *China*, bear off their
urſes on *each Side of the Line*, at leaſt *ſix-*
Degrees, to take the ſaid Winds at their
t Advantage.

So manifeſt it is made, by the *former Section*
Irregularities reconcil'd——, that the proper
genuine Motion of the Tide, is true
th and *South*, without any Deflection to-
rds *Eaſt*, or *Weſt*; ſave what's occaſion'd
thwarting Coaſts, or *Channels*, of a different
ection: And that the *Eaſtern* Trade-wind
s naturally bent to diſtract it, with all its
h and *North-eaſterly* Variations; the for-
r depending chiefly on the *Meridional Preſ-*
of the *Moon*; and the latter on the *Air's*
ifaction, purſuant to the Diurnal Courſe of
Sun: And it is finally made remarkable,
this of *Occaſional Calms*——, that thoſe
cts of Sea, wherein theſe *Calms* reſide,
Hurricans domineer, are only *Elbows of*
Ocean; or at leaſt lie little obnoxious to
Diſturbance, from the two Motions of the
e and Wind aforeſaid.

CHAP. III.

How *the Tide is propagated, and ſpread* o our Weſtern Ocean; *with ſpecial Reg to* Time *and* Place.

SINCE I have hitherto only *ſionally* diſclos'd the Nature of Tide, and its Production; in former Chapter, with regar *Time*, and in the latter as to P thro'out the Ocean; without inſiſting fa on either of thoſe Circumſtances, tha draw the *Inſtances*, ſo remark'd, into one tinued Series of Diſcourſe, by way of and *Effect*: In order to evince the Sun Moon, to be the ſole *efficient Cauſes* o Tide; and their Preſſure the *inſtrum* *Means*, whereby it is effected: And this the Atteſtation of the daily *Experience*, conſtant *Obſervation* of *Navigators*; as their *Senſes* cou'd inform 'em, and their expreſs it.

But as to the *Manner*, how this great W perform'd, eſpecially in *our Weſtern* which is beſt known to us; and why propagated by *Libration* in the *Ethiopick* and ſpread over the *Atlantick* by *Und* (which are cauſed alternately by thei *ſence*, and *Abſence*;) hence I deſign Place *where* the Water makes, by the mon *Lines of the Sphere*; and chiefly wi ard to the *New* and *Full-Moon* Tides, which intly obſerve the ſame Solar and Lunar Hours, and are thoſe whereon the reſt de- end.

And to expreſs the Time, *when* the Water is affected; the *Horological* Characters I, V, , are inſerted in the *Squares* within the ſaid *ines*, to ſhew its Terms and Periods of *Time*; hile the *Darts* interſpers'd among 'em, point t their *Tendence*; and this alſo by *a Map*, to ew their Diſtances, and Bearings, as to *ace*; that all may be render'd at one View, viſible to the *Eye*, as it is perceptible by the *derſtanding*: And firſt, by a Draught of the *a in general*; to ſhew the Natural Conſtitu- n of the Tide, in its *greateſt Amplitude*; d afterwards by *more particular* ones, to ex- bit its Application to their *ſeveral Diviſions*, er a more ſpecial Manner.

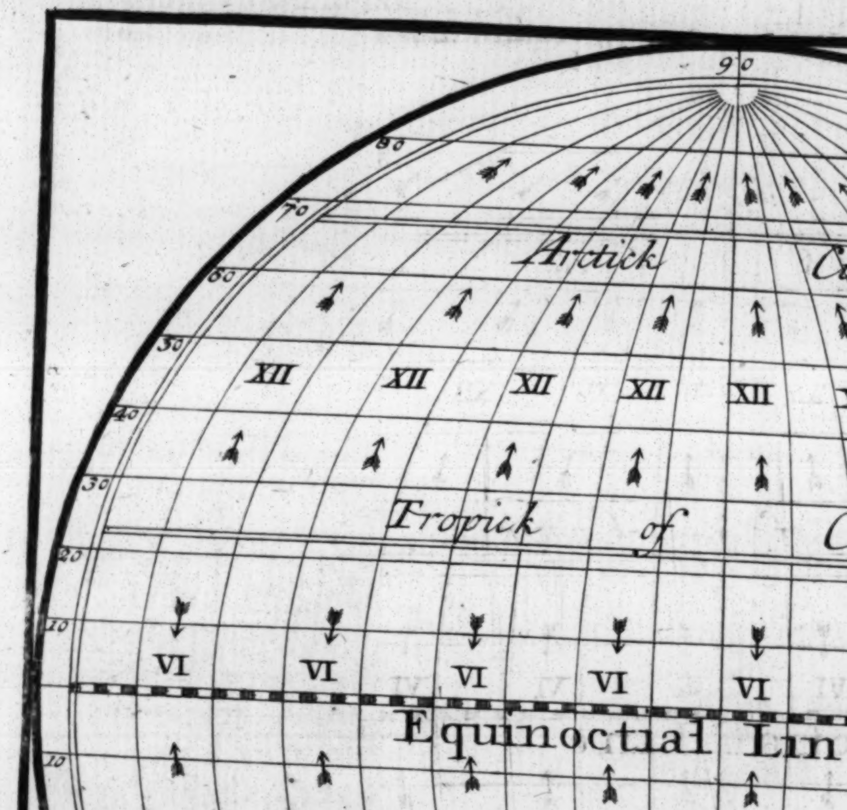
SECT. I.

the Application of the Tide to the Globe in General; *with regard to the principal* Lines *of be* Sphere.

NOtwithſtanding our Terreſtrial Globe were *univerſally ſurfac'd* with Water; , nevertheleſs, it wou'd *ſtoop* as low in the oon's Preſence, and *rebound* again as high her Abſence, upon any determinate Point, *ween the Tropicks* (where her Preſſure is ſt intenſe) as it does at preſent: And con- uently, there muſt be High-water *where* ſhe Riſes, and *when* ſhe Sets upon the *ſam* Place, as lying at the fartheſt Horizontal-Diſtance *Eaſt* and *Weſt*, from her *Culminating Point:* Hence the Figures VI^s, are placed upon the *Equator,* and properly belong to al that Space of Sea, *between the Tropicks,* to denote the *Hour* of High-water, not only upo the *Lines* whereto they are affixed; but alſ on all the reſpective *Meridians,* within th ſaid Space, ſucceſſively from *Eaſt* to *Weſt,* purſuant to her Diurnal Motion around the *Hemiſpere.*

And, foraſmuch as where the Moon *culminates,* between the *Tropicks,* is made th *deepeſt* Depreſſion; from whence reſults th *higheſt* Tumour, beyond 'em; as it were b *Rebound,* from the one Extream of *Depth,* t the other of *Height,* by the ſhorteſt and directeſt Lines; and with the greateſt *Force,* an *Expedition* poſſible: And the Tumour ſo rais' muſt *fall back* again by the ſame Path, in the *Vacuity* whence it came; to advance *an ther* in the ſame Place, to near an *equal* Heig with the beſt Advantage; and ſo *alternat* raiſe each other by *Counter-Libration,* on ea Side of the *Tropicks,* upon the ſame *Meridian* Hence the XII^s, which denote the Time, a Place of the Floods without the *Tropicks,* a placed upon the ſame *Meridional Lines* (wi their reſpective VI^s within 'em) upon the *Parallels* proper for them.

Now, in regard the *Angle* of the Preſſur *Incidence* upon the Bottom of the Sea, whe on it falls; and of the Flood's *Emergency* fr it, are the *ſame*; and the Axe of their *Li tion* muſt be *Equidiſtant* from 'em both: Sin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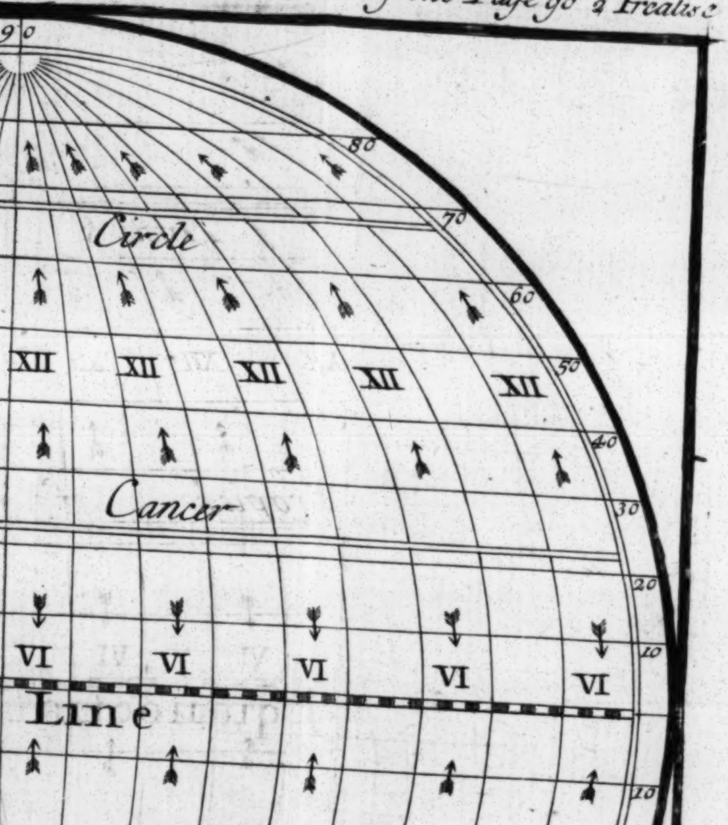
To front Page 90 2d Treatise



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the *Axes* of the Tides, on each Side of the *Equator*, are found by Experience to be *the Tropicks*; and theſe, lie about *twenty-three Degrees* diſtant from it: Hence the XII^s; without the *Tropicks*, are affix'd at double the Diſtance of *twenty three* Degrees from that *Line*, on the *Parallels of forty-five* Degrees in both Latitudes; to correſpond to each other in that Diſtance, and ſtill continue upon the *ſame Meridians*, with their reſpective *Equinoctial* VI^s; which are the Lines of the Tide's *Libration*, and change ſucceſſively *every Moment*, according to the Diurnal Courſe of the Moon; hence thoſe XII^s, and theſe VI^s are inſcribed; thoſe on their *Parallels* and theſe upon the *Equator*, around the Globe, at *equal* Spaces; to expreſs the *Diurnal Succeſſion* of High and Low-water, from *one Meridian to another*, for ever.

Moreover the ſaid *Axes*, whereon the Tidal *Libration* alternately revolves, ſuffering no ſuch Protuberance themſelves; and lying extended *directly from Eaſt to Weſt*, leave the Poiſe of the Water a *free* Liberty, to ſway the riſing Tumours, according to their own *Inclination*, indifferently either towards *North*, or *South*: Hence the *Darts*, in the bordering Squares, ſtill point forwards the *ſame* Way; to direct their *Settings* perpendicularly, either towards the VI^s, inſcribed on the *Equator*; or towards the XII^s, upon the *Parallels* aforeſaid; which is as far, as the Activity of the ſaid *Libration* properly extends.

Finally, the two Ranks of *Darts*, which are placed beyond the ſaid *Parallels*, on both Sides of the *Polar Circles*, ſtill direct the Setting of the Tides to the *Norward*: which, being propagated by *Undulation*, make no remarkable Returns; their wavy Billows, either reaching the *Poles* themſelves; or elſe *ſubſiding* at laſt into ſmooth Water, ſuppreſs'd by their own Weight.

Such is the *Theory* of the *Courſe*, and Conſtitution of the Tide, as deſcribed by the *Lines* of the *Sphere*, upon a *boundleſs Ocean*: Now, to apply the ſame to practiſe upon the *Sea*, as it lies actually *confin'd* by the *Coaſts*, and *Shores*, of our terraqueous Globe; that what *Speculation* has already propos'd in general, as moſt agreeable to Reaſon, may be found by *Experience*, to be Matter of Fact; in the Places moſt concern'd, thro'out the Univerſe; I begin with the Diſplay

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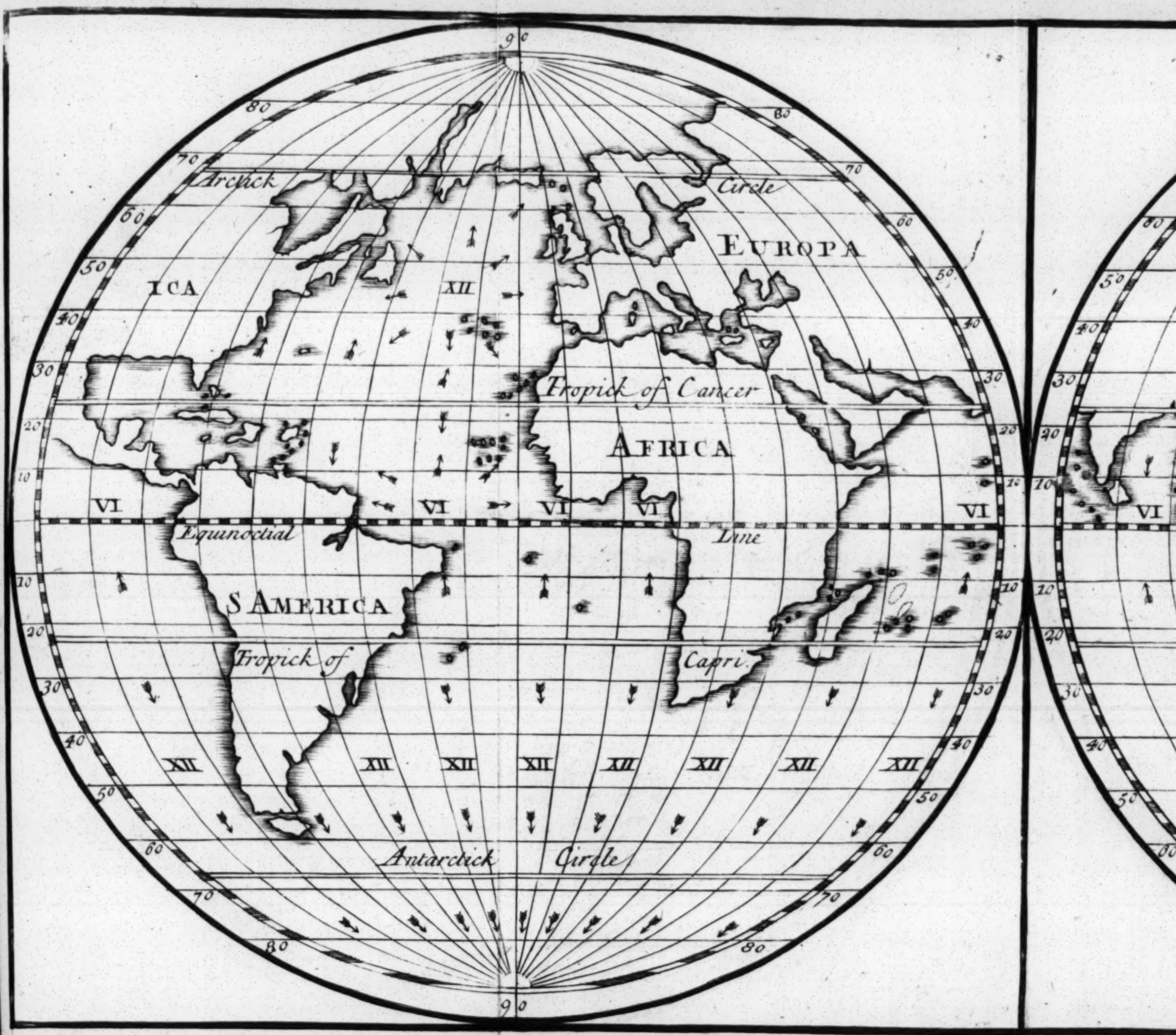
SECT. II.

Of the Tide's Application to our Weſtern Ocean; *with a ſpecial Regard to the* Ethiopick *Diviſion.*

TO deſcend from the Conſideration of the *Sea in general*; to the farther Inſpection of our *Weſtern Ocean*, in particular; with reference to the Tide's Reception, it lies extended from the *Artick*, to the *Antartick Polar-Circle*; divided into *two* Seas, with an *open* and free Paſſage betwixt 'em, for the Intercourſe of its Floods out of both *North* and *South* Latitudes: And to enter, in the *firſt*

Place,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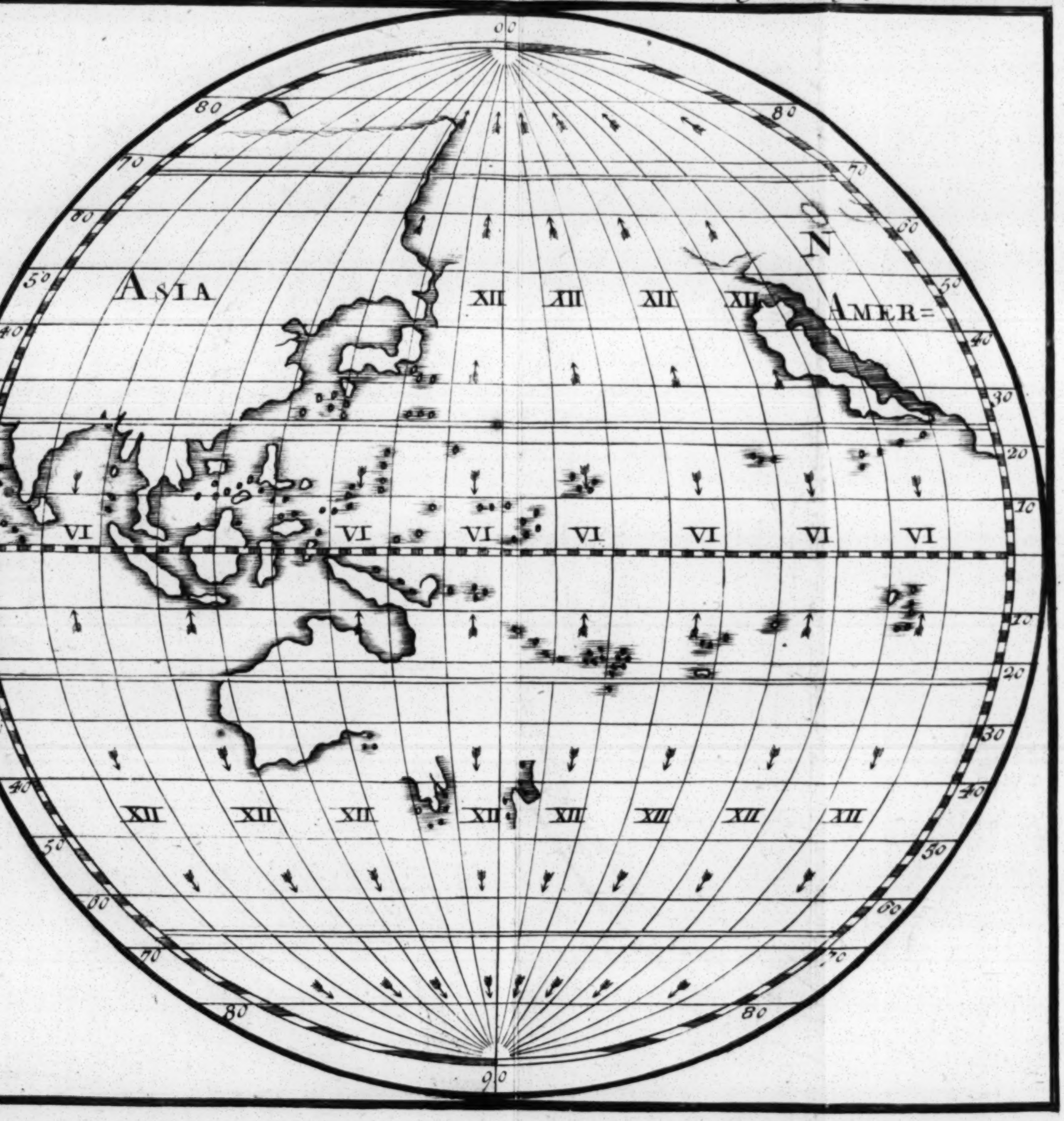
XII
Antarctick Circle

To front Page 92 2d Treatise



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ace, upon the Survey of the *Ethiopick* Part, hoſe Figure is pretty *Regular*, and Situation ore *Oriental*; it is obſervable, that its *Eaſtern* ore lies *North* and *South*, from near the eight of *Benin*, to the *Cape of Good Hope*, for *ty Degrees* together; to give the *Morning* ood its proper Direction:

And withal, to ſerve for a Pattern, to draw e more *Weſterly* Lines of the Tide's *Libra-* , Parallel to itſelf; and with a ſingular *iformity* amongſt themſelves (conformable that which is already deſcribed in the *gene-* *Map* of the Globe); and ſo *cloſe* to each er, thro'out that Sea, to the *Eaſtern Coaſt* *Braſil*; as to carry the Succeſſion of the des, *thitherward*, Line by Line, concomi- tly to the Diurnal Motion of the Moon, m her Riſing towards her Setting; as far he Breadth of that Sea extends; while the *th Coaſt* of *Guinea*, which ſtretcheth itſelf ward from *Eaſt* to *Weſt*, along the *Northern* *re* of this Sea's Diviſion, ſerves for a *Scale*, emark the *Hours* and *Minutes* of their Con- nitancy, for *five hundred Leagues* to the *ſtward*: Let us conſult the *Pilot's Obſervation*, on this Point; and take his Word, illu- ted with *a Map* that's drawn according to own Direction, for an undeniable Prin- le.

To begin the ſaid *Series* of Floods, at the *ermoſt* Part of the Gulph, the *Engliſh Pilot* *Guinea*, aſſures Us; " That at *R. Gabon*, pon the *Equinoctial Line*, an *Eaſt* and by *North* Moon makes High-water, at V¾; nd at *R. Danger*, an *Eaſterly* does the ſame,

" about VI: At *Monamba's Hole*, an *Eaſt*
" and an *Eaſt* by *S.* Moon, at VI, and VI
" At *Bato*, and *Camaroon*, an *Eaſt*, at VI: S
" at *R. Rey*, does an *Eaſt*, and an *Eaſt* b
" *South* Moon, at VI, and VI$\frac{2}{3}$; At *Beni*
" an *Eaſterly* Moon fills all full, at VI; an
" at *Caran*, an *Eaſt*, and *Eaſt* by *S.* one,
" VI, and VI$\frac{2}{3}$; and paſſing along the ſam
" Coaſt to *Gojaven*, a *North-Eaſt* by *E.* an
" an *Eaſt N. E.* Moon makes the Water flo
" there, at III$\frac{2}{3}$, and IV$\frac{1}{2}$: And a little fa
" ther at *Swine*, an *E.* Moon ſwells the W
" ter, at VI: And following the Shore
" the utmoſt *Weſt*, at *R. Serbera*, the Wa
" flows with an *Eaſt* by *South* Moon, at VI
So cloſe does the *Weſtward* Motion of
Tide, ſtick to her *Diurnal Courſe* all the whi
for *five hundred Leagues* together.

Now, to demonſtrate that the Tide f
lows her ſaid Courſe, to the *Weſtward*
cloſe, both for *Succeſſion* of Time, and Hei
of Water, and flows as conſtantly at XII,
on the Parallel of 45 *Deg. S. Latitude*; a
doth upon the *Equator* near VI, along
Coaſt of *Guinea*.

Firſt, As to the Account of *Time*; the
ter flows, on Change-days, at *Port Deſire*,
27 Deg. *S.* Latitude, upon the *Weſt Ame*
Shore, exactly at XII, the Moon being v
cal; and, *Secondly*, As for *Height* of Floo
51 Deg. *S.* Latitude, it is not wanting in
R. Gallegos, upon the ſame Shore, (w
riſeth and falleth 60 *Feet.*) to *equalize* ou
the *Weſtern* Coaſts of *Europe*, at the ſame
of *N.* Latitude: Without the Concurren
the *inclining* Shores, and *ſhallow* Bottoms,

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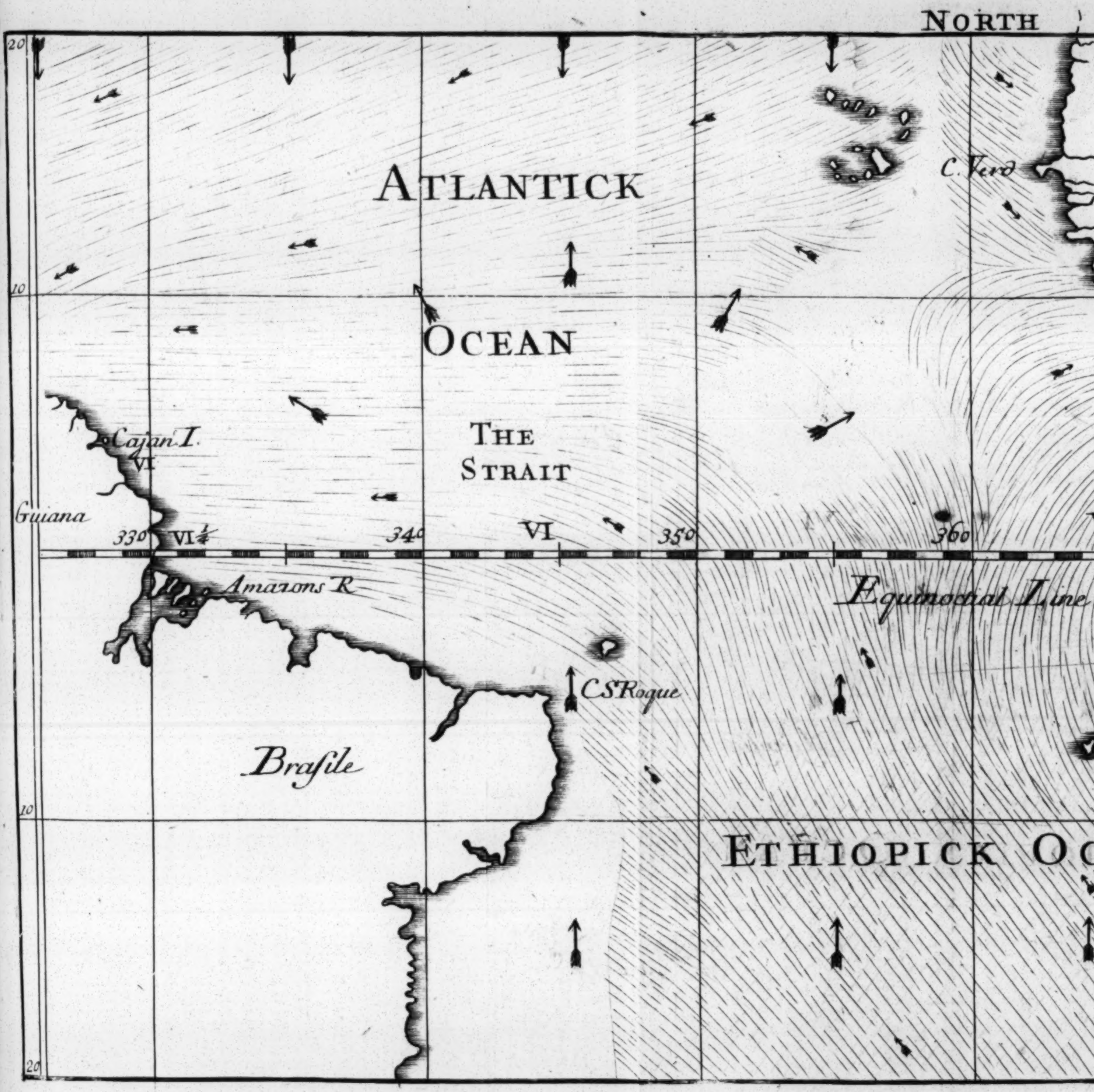
NORTH
20
ATLANTICK
OCEAN
C. Verd
10
THE
STRAIT
Cajan I.
VI
Guiana
330
VI¼
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Amazons R
Equinoctial Line
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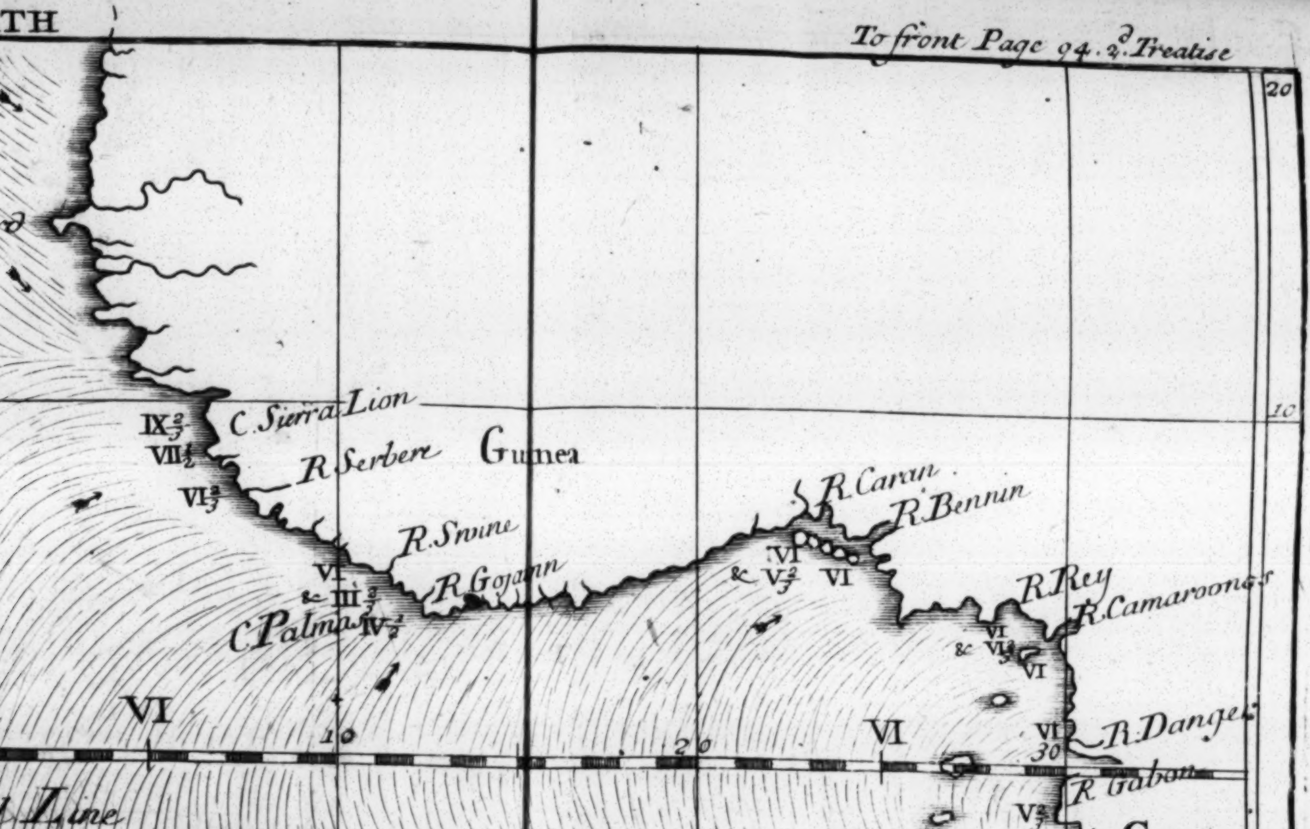
To front Page 94. 2d Treatise



ent in our *narrow Seas*; and ſo may for a *Standard* both of Time and Tide, g the ſaid *American* Shores, from 47 Deg. Deg. *S.* Latitude, that is, from *C. Blan-* *C. Horn*; the various Ins an Outs of the *s Declivity*, being conſider'd.

d if it be *objected*, that, in the Mouth of *Magellanick Streight* (which lies but one ee from that *River*, and ſcarce 4 Deg. the ſaid *Port*) the Flood riſeth not *half* as at the one, and yet makes High-water *by an Hour*, than at the other: It is *re-* that the Streight is flooded there *irregu-* in both reſpects: For,

As to the *former*, *viz.* That it riſeth Fathom inſtead of 10, as in the ſaid ; the Bay, which is the *Entrance* into id Streight, *contracting* its Sides towards ottom, into a *narrow Gullet*, opens itſelf into a *ſecond Bay*, of an equal Extent: e the Flood, by its paſſing *thro' it* out of e into the other, *loſeth* half of its Height former; and *repaſſing* it, keeps up its s much, by way of *Reſtitution*; eſpecial- ng ſwell'd by the *Occourſe* of the Streight's y Current, from the *Eaſt*; the Tide of and Ebb, running *ſo ſtrong both ways*, ately, as not to be ſtemm'd; tho' ſcarce diſcern'd in the *Streight's Mouth*, which fix'd all the while, within the Com- f 4 *Fathom*; as being the *Mean* betwixt o *Gallego's* Extremes, which it never th.

, Foraſmuch as the *Streight* receives the in ample Manner, with an *open* Bay, is rais'd proportionatly with its Stream,

which goes on *decaying* 'till High-wat
Whereas its Current, being *ſtraitned* by
ſaid Gullet, goes *encreaſing* all the while;
latter muſt needs take off the *Top* of the
mer, at leaſt *an Hour* ſooner than ordina
Hence it comes to paſs; that, as the Tide in
Streight's Mouth, neither ſwell'd ſo high,
ſunk ſo low as in the *River Gallegos*;
withal ſurceaſeth to riſe, before it does ſ
Port Deſire; yet, at *all three Places*, the j
Tidal Supplies were added and withdrawn
the *ſame* reſpective *Inſtants*, and alſo in e
Meaſure.

After all, ſince the abovesaid Tide at *Ga*
neither iſſued out of the *Eaſt*, whence
Sea nor *Gulph* cou'd be found to ſupply
nor was it brought along by the *Current* f
the *Weſtward*, which directly *oppoſed* its Co
much leſs was it favour'd by the *Atla*
Flood out of the *North*, which bore
ſtrongly *againſt* it; but was wholly ſupp
by the *Ethiopick* Tract of Sea, which
open to the *South*. And in regard the T
between the Latitude of *Port Deſire*, and
River Gallegos, moſt abounds with Water,
at XII, when the Tide at *Gabon* wants i
VI, and on the Converſe; hence the
muſt needs *ſupply* the other; and both T
muſt be equally co-extended *Eaſt* and
to do it *ſucceſſively*, according to the *Di*
Conduct of the Moon, already deſcribed.

And their mutual Correſpondence is
on Foot by *Libration*; as plainly appear
the *Counterpoſing* Tumours, at each En
the *Ballance*; the one near the *Magell*
Streight, which is vaſt for *Height*; and
c

her upon the ſaid *South-Guinean* Coaſt,
hich is as formidable for *Speed* and *Force* :
hile at St. *Helen*'s, near its *Axe*, the Surface
the Water riſeth or falleth *ſcarce a Foot*:
ch *furniſhing* the other with new Recruits
Stream, and *fetching 'em off* again alter-
tely, without Intermiſſion.

Thus the Tidal Tumour *ſwells* with the
ing Moon, and *ſinks* again in the *Ethiopick*
act of Sea, with her *Southing* Preſſure up-
the *Equator* ; and the *Lines* of its alternate
proach thereto, and *Receſs* from it, lying
rallel to the *Eaſtern* Coaſt (which gave 'em
eir firſt Direction) fall *Perpendicularly* upon
at Line, with the ſame Uniformity, that I
ve already deſcribed, in the *Univerſal Map*
the Globe ; while the Moon, purſuant to
r Diurnal Motion from *Eaſt* to *Weſt*, ſuc-
ſſively *depreſſeth* the Water's Superficies,
ithin the Tropicks ; to raiſe it again by *Li-
ation, beyond* 'em, at the very *ſame* Inſtant ;
at, what ſhe *expels* by her Preſſure, from
e *one* Side ; may be fetch'd *back again* from
e *other*, by its own *Weight*, with an alternate
eciprocation.

So fitly, in every reſpect, doth the *re-
lar* Appearance of the *Ethiopick* Flood, fall
(for an *Example*) to eſtabliſh the Preli-
inary Account already given of it, in the
eſcription of the *Sphere in general* ; nor will
e manifold *Anomaly* of the *Atlantick* Tides,
hen duly conſider'd, more prejudice the
alidity of that *General Rule*, by way of *Ex-
tion* ; than the Conditional *Proviſo's*, do
e Obligation of a *Bond* ; but, on the con-
trary,

trary, ſerve both to *explain*, and *enforce*
Let us try the Experiment.

SECT. III.

Why the Atlantick *Flood is not devolv'd diurn* *to the* Weſtward, *like the* Ethiopick; *makes full Sea from* Eaſt *to* Weſt, *at the ſ* *Inſtant.*

WHEREAS the Lines of the *Tide's* *bration*, lie ſo uniformly extend *North* and *South*, on the *Ethiopick* Side of *Equinoctial Line*, as I have declared, to g its Floods, and Ebbs, a ſuitable *Reciprocati* on the contrary, the *Atlantick* Diviſion of *Weſtern Ocean*, being neither of a *Rectili* *Figure*, to give 'em any ſpecial Directi nor of a *regular Shape*, to conform 'em ſuita each to other; all the ſaid Lines, are c fuſedly *involv'd* into one; and that alſo, comes as *variouſly deflected* either to the E or *Weſtward*, according to the Declivity its Shores; *Cape Virde*, and its adjacent *Iſla* giving that *Atlantick* Flood, at its firſt pearance, a *Weſterly* Turn towards the C *bees*, for at leaſt *twenty Degrees*; which Coaſts of *Florida*, *Virginia*, &c. up to N *found Land*, as briſkly return full *thirty Deg* again to the *Eaſtward*; and it is ſtill devo from *both Sides*, into the *Middle Channel*, wh it rowls with moſt Freedom, and muſt f all at once, as it were, with *one ſingle* tion.

Bef

Beſides, the Bluntneſs of the *Moon's At-*
ſphere, univerſally affecting the *whole Sur-*
of that *Atlantick* Tract of Sea, between
Tropicks (as it were a *Lake*), without any
nſiderable *difference* of Preſſure ; the pon-
ous *Self-coherence* of the Water, ſo general-
affected *at once,* cannot *ſucceſſively* reſent the
preſſion, with any ſenſible *Diſtinction* ; and
nſequently its Superficies muſt fall or riſe
ther, co-extenſively from *Eaſt* and *Weſt* ;
m the *African,* to the *American* Shore ;
t is, from the *one End* of its Tidal *Axe,* to
other ; as it plainly appears to do, by Mat-
of Fact. For,

As at *Cape Bajador,* at the *Eaſt* End of it,
the *African* Side ; the Water flows with a
Moon, exactly at XII ; ſo alſo at *Carolina,*
the *Weſt,* on the oppoſite *American* Coaſt,
ſwells with an *E. S. E.* Moon, at VII$\frac{1}{2}$;
ng diſtant from each other *ſeventy Degrees* in
ngitude ; which correſponds to *four Hours*
an half of Time, upon the *Horoſcope* ;
ich being *added* to VII$\frac{1}{2}$, makes the Num-
XII compleat, for the Water to flow, at
two *ſo far diſtant* Places, juſt at the ſame
ment.

Again, Since the ſaid *Librative* Motion
ctly requires, that the *counterpoſing* Arms of
Ballance, be diſpos'd jointly the one to *aſcend,*
d the other to *deſcend* at the ſame Inſtant ;
d conſequently each of 'em, according to
and *every* Part, at whatever Diſtance from
Axe, muſt attain *at once* to its utmoſt
ght, or *Depth* reſpectively : So muſt the
antick Tide acquire its *Summits* of Flood,
Ebb, at the *ſame* Time, at *all Diſtances* of

Latitude from its *Northern Tropick*, to *forty-f*
Degrees of Latitude; and as far towards the E
and *Weſt*, as its *Libration* extends: As it actu
ly happens, at *Gay-Head* in *New-Englan*
where the Moon, at *S. E.* by *E.* make Hig
water at VIII$\frac{1}{4}$; being diſtant from *Ca*
lina fifteen Degrees N. Latitude, and about *ele*
Degrees in Longitude, which correſponds to $\frac{1}{4}$
an Hour; which, being added to the VII$\frac{1}{2}$
Carolina, adjuſts the Account of the Tide
Gay-Head, at VIII$\frac{1}{2}$, to an *Inſtant*; witho
any Conſideration had to the Diſtance in L
titude at all.

Moreover, foraſmuch as the Moon's Pr
ſure, affects the *whole* Space of the *Atlanti*
between the *Equator* and the *Tropick*, co-
tenſively from *South* to *North*, as well as fr
Eaſt to *Weſt*; and with that Conformity,
to raiſe the Tide by *Contrapoſition*, at all
three Places above-mentioned, at the *ſame* I
ſtant, tho' at *ſo great a Diſtance* from each
ther, both for Longitude, and Latitu
Hence the Tide ſo rais'd, to anſwer the Pr
ſure's *Extenſion*, muſt affect, with the *ſame* R
gularity in every reſpect, not only the *ſo*
diſtant Places, and the *Lines* of Diſtance
tween 'em; but alſo the *Area* deſign'd the
by, and contain'd therein: That is,
whole Body of the ſaid Water, between
Tropick, and the Parallel of *forty five*; from
African Shore to the *American* Coaſt, ſo as
ſwell it all *at once*, according to its wh
Extent.

And, if it be *objected*; That a *Sout*
Moon makes a regular Tide, upon the *Co*
of the *Atlantick*, at XII; as being dire

c

ounterpoſed to her Noon-ſtead Preſſure, beween the *Tropicks*, at VI; an *Hour* later, han at the *three Places* above-mentioned; as ppears by the Tide at C. *Bajador*, which alſo nakes with a *Southing* Moon, *fifteen Degrees* nore to the *Eaſtward*, an Hour *ſooner* than it; nd conſequently ſo much ſooner than its ther two contemporary Floods at *Carolina*, nd *Gay-Head*: It is *reply'd*, that the Tidal Tumour is rais'd *over-haſtily*, at all thoſe *three laces* at once, by a prepoſterous Check: irſt, at C. *Bajador*, by the inclining Shores f the *Canary Iſlands*, compreſſing its Stream n the *one* Side, and of the *Continent*, on the *ber*: The like is done by the *Carolina Coaſt*, Oppoſition to the *Bahamean Bank*; which, pening *wide* to receive the Stream, *contracts* to a Point in the *Mouth* of the *Gulph of Floda*; whoſe Current *drives* the Flood with ſo uch Precipitation againſt the *Shore*, that it akes at VII½ a *full Hour* ſooner, than in *hley R.* tho' upon the *ſame* Coaſt, and not ove *two Degrees* diſtant from it. Laſtly, the omontory of *Gay-Head* (as C. *Palmas* at the ntrance of the *R. Gojaven*) haſteneth the ood as much ſooner, than it makes in the *ginean Sea*, whence it ſets; or, than in the *lph* along *New-England*, which receives it.

So exact is the Conformity of the ſaid Priry Tides, with each other, between the *pick* and the *Parallel* aforeſaid; and (abacting from the Impediments of *Coaſts* and *res*) with the Central XII, which, in the iddle of the *Atlantick*, has free Liberty to ell and ſink at regular Hours, without any ſorder; and ſo well prepar'd is the *Plan* of that Tract of Sea, for a *ſecondary Sort* to be rais'd upon it. Let us ſee with what Accord it is effected.

SECT. IV.

Concerning the Circular Transfuſion *of the* Secondary *Tide; and, how it correſponds* wit *the* Libration *of the* Primary *one.*

NOtwithſtanding the Co-extenſion of th Moon's Preſſure, to all that Tract o the *Atlantick* already deſcribed; ſo as to ad juſt the *Primary Tide* to itſelf, thro'out the ſai Extent of Sea, to the *ſame Inſtant*, from th very Nature of its *Libration*; yet, as to th Part of the ſame Tidal Wave, which kee cloſeſt to the Sea's *Central Meridian*, where rowls in *deepeſt* Water, and flows in the *rectest* Channel, from the *Tropick*, its ſuppoſ *Axe*, towards the *Pole*; it muſt needs r *higher* than the reſt of the Ocean: And t farther this Flood paſſeth *beyond* its *Axe*, t more it muſt be *advanced*, even to the Su mit of its Lift, at the Parallel of *forty-five* D *grees* Latitude; at an equal Diſtance from *Equator*, whence it was forced: And no upon its Return thither, it *ſinks* again, be depreſs'd by its *own Weight*; and raiſeth round its Apex, by *Reſult*, (as a Stone let into a *Lake*) a *Secondary* Tumour; which *fuſeth* itſelf Circularly by *Undulation*.

Now, to deſcribe the *Circular Diffuſion* this *Secondary* Tide, in reference to the *T* and *Place* of the *Primary* Sort; the *one Fo* the *Compaſs* is to be ſet upon the Point, wh

mark'd in the *Map* with XII ; where the
entral Meridian of the ſaid Sea, *interſects*
e Parallel of *forty-five Degrees* Latitude,
hence its *Tranſfuſion* is made : And the *other*
to be extended *Eaſtward*, to the Promonto-
es of *Europe* ; as for Inſtance, to C. *Finiſter*
Spain ; and turn'd thence *Weſtward*, to the
relands of *America*, to *Manomy Point* in *New-*
gland : Whence it will plainly appear ;
at their oppoſite Shores lie at about *ſixty De-*
es of Longitude from each other, as to
ce ; and allowing the Diurnal Courſe of
Moon *fifteen Degrees*, for an *Hour*, they
at *four Hours* Diſtance, of *Time* ; which is
be accounted the *Diameter* of its Circuit,
Sphere of its Activity, within the interja-
t Ocean.

And, foraſmuch as the Moon cannot reach
ſaid *Central Meridian*, to make High-water
er Central Noon-ſtead XII, 'till ſhe has
ſ'd the *European* Promontories *thirty* De-
es, or *two Hours*, after her Southing at
iniſter : And paſſing forward *fifteen* Degrees
her, to the *Weſtward* of the ſaid *Meridian*,
es High-water at the *third Hour* after her
hing at the Places aforeſaid ; that is to
at III in the *Afternoon* ; according to
ervation : Hence it is manifeſt, that while
dvances forward *Weſterly*, fifteen Degrees,
ne Hour, upon the *Horoſcope* ; the Tide
eth itſelf *back* again to the *Eaſtward*, thir-
egrees upon the *Globe*, as far as *C. Finiſter*.
ow, in regard *Monomy Point* lies to the
ard of the ſaid Central Line, as *C. Finiſter*
to the *Eaſtward* thereof ; and both at
Degrees, in *Longitude*, diſtance from it ;

ſo that the Moon, at once, appears at th *former* Place, at X in the *Morning* ; and at th *later*, at II *Afternoon* ; and when ſhe Culminates upon the Central XII, as lying *Equid* *ſtant* from 'em both, and being the Point fro whence the Tide *diffuſeth* itſelf towards *bo* Places with *equal* Speed ; and conſequentl affects 'em at the *ſame* Time ; the *one*, as XII at Noon ; and the *other* as at II in t Evening, with regard to her *preſent* Poſitio Yet, in Conſideration that High-water *reach* neither Place, 'till ſhe has paſs'd the ſaid Li *fifteen* Degrees to the *Weſtward* ; that *Ho* *Space*, which was *added* to the II at C. *Finiſ* to make Tide at III ; muſt be *ſubſtracted* fr the XII at *Manomy Point*, to leave XI onl according to Obſervation.

Now, to turn the *Compaſs* around upon Central XII, according to the *ſame* Exte as ſoon as this ſpreading *Secondary* Tum toucheth C. *Finiſter* at III ; it doth the l to the *Eaſterly* Promontories of *Europe* ; f the utmoſt *North* of *Ireland*, to the far *South* of the *Canaries* : So on the opp Coaſt of *America*, the ſaid XI, is der from *Manomy Point* in *New-England*, to *mouth River*, *Boſton Harbour*, the *R. Pene* *&c.* towards the *Norward*, as far as the C paſs of our *Obſervation*, and the Sphere o *Activity*, extends ; while the *Primary* F ſupplies the *Remainder* of its Circle, be that Extent ; from C. *Bajador* in *Afric* C. *Florida* ; and thence along the *Am* Shores, up to *Gay-Head* in *New-Englan* the *ſame* Inſtant : So exact was the Ac of the *Primary* Tides, amongſt themſ but how it comes to paſs, that this *Secondary* Sort, which conſiſts of *one* ſingle *Hour's Diffuſion,* ſhou'd affect the Places aforeſaid, *three Hours later* than they ; will more fully appear, in the following *Section.*

SECT. V.

f the mutual Occurrence of the Primary, *and* Secondary *Tides, at the* Places *aforeſaid.*

THE *three Hours* Precedence of the *former Sort* of Tides, being already einc'd, by many Inſtances produc'd for that urpoſe ; and concerning their mutual *Occurces,* I here only inſiſt upon thoſe *four Places,* hich are remarkable, for the joint *Continuce* of both their Circuits in one, *viz.* at *Bajador,* and the *Canaries,* on the *African* de; and *Gay Head,* and *Manomy Point,* on e *American* Coaſt.

Concerning their *former* Conjunction, the *ineon Pilot,* tells us in general Terms ; that S. Moon makes High-water at the *ſaid Cape,* XII ; and a *S. W.* Moon, at the *more Weſter-* f thoſe *Iſlands,* at III ; that is, *three Hours* r; leaving us to calculate the ſeveral Innts of *Time,* and Points of *Place* of their mediate *Occurrences* ; from her correſpontly diverſe Aſpects, all the while.

Contrariwiſe, our *Weſt-Indian Pilot,* to ſae our Curioſity, even to the niceſt *Partirs* of their ſaid Occurrences, from *Gay d* to *Manomy Point,* in both reſpects : After

ter an accurate *Deſcription* of the Coaſt of *New-England*, he gives us a general *Tide-Table* for the whole Extent; to which he ſubjoins a *Map*, which ſpecially exhibits the *Situation* of the *Gulph*, on the *South*-Side of thoſe Territories, where the Tide arrives firſt at *Gay Head*: From whence the *Tide-Table* deſigns its Traverſe Paſſage, for *three Hours* Space; that is, from *Gay Head* at VIII½, 'till it meets with the *Secondary* Tide, at *Manomy Point*, at XI½; to make his *three Hours* Computation of their Occurrences here, to correſpond exactly with that at C. *Bajador*; and withal to expreſs, after a more ſpecial Manner, the *Points*, and *Inſtants* of the Performance. Take here (according to the *Pilot*'s Appointment,)

The General Tide-Table *of* New-England

High-Water at the		The Moon		*Hou*
	N. W. Point of *Block-Iſle*, and *Gay-Head*.		*S. E.* by *Eaſt.*	VIII
	Harbour of *New-London*. *Eaſt*-End of *Fiſher*'s-*Iſle*, and *Tarpolin-Cove*.		*S. Eaſt.*	IX.
	The *Horſe-Race*, and *Cape-Poge*.		*S. S. Eaſt.*	X
	Manomy Point. *Plimouth*, and *Boſton* Harbour. *Penequid* River.		*S.* by *Eaſt.*	XI

To deſcribe the *Courſe* of the Tide, th that Coaſting Gulph; according to the *T ble*'s Account, and the *Map*'s Direction;

Firſt, The Flood *ſets* from the S. Sea in that Gulph, thro' the *Streight* between *Lo*

Iſle and *Martha's Vineyard*; and is divided in its Paſſage, into a *Weſtern* and *Eaſtern* Curent; the former, being deflected by *Mentock-Point*, towards the *N. W.* Cape of *Block-Iſle*; while the Backſide thereof, deflects the other Branch of the Stream *Eaſtward*, towards *Gay-Head*; where, upon an *equal* Repulſe, the Flood is made to ſwell at both Places *at once*, o wit, at VIII ¼; an Hour *ſooner* than elſewhere, upon that Coaſt; but exactly when t makes at *C. Bajador*; tho' above a *thouſand Leagues* diſtant from it.

Next, The *Weſtern* Current, deflects its Courſe to the *S.* End of *Fiſher's-Iſle*, while the *Eaſtern* paſſeth to *Tarpolin Cove*; and both ſwell at IX, (which is near the *regular* Hour) n accord with the *Central* Flood of the *Atantick*, at XII; which, being alſo of the *Primary* Sort, and rais'd by the ſame *Libration*, ſwells near the *ſame* Time; all Impediments eing remov'd.

And, to paſs from *Fiſher's-Iſle*, to the *Horſe-Race*, which runs between it and *Gull Iſle*, where he Water *ripples* for haſt, both at Flood and Ebb, tho' the Channel be *twenty Fathom* deep; et the Tide (having the Gulph to fill as far s *New-York*) floods not, 'till the *Eaſtern Curnt* have crept over the Sands, to *C. Poge*; hat is, at X ½; an Hour an a half *later*, than t the *S.* End of the aforeſaid *Iſle*.

After all, this Stream reacheth *Manomy oint*, at XI ¼, where it meets with the *Sendary* Tide; which arrives there from the *entral* XII, at the *ſame Inſtant*; and *three Hours* later than it made at *Gay-Head*, *viz.* at III ¼; and at the ſame *three Hours* Diſtance,

that

that the *Secondary* Flood occurr'd to the *Pri-*
mary XII, at C. *Bajador*, *viz.* at III After-
noon.

Hence plainly appears, 1*ſt*, That the *Pri-*
mary Tide, which devolves from the *Centra*
XII, requires only *one Hour*'s Precedence, to
ſpread the *Secondary* one over the *Atlantick*, t
the utmoſt Extent of its Circuit : 2*dly*, Tha
it acquires but *one* ſingle *Hour's Acceleration* ex-
traordinary, by its Appulſe to C. *Bajador*, an
Gay-Head ; where it obtains a *ſecond Hour*'s Pre-
cedence, before the ſaid *Secondary* one
3*dly*, That the *third Hour* is advanc'd only r
ſpectively, to the different *Poſition* of th
Moon ; which, by her Diurnal Tendence
the *Weſtward*, *fifteen* Degrees beyond the *Ce-*
tral Meridian, ſeems to *add* to the *Eaſter*
bound Tide, an *Hour*'s Retardation ; to ma
at III, inſtead of II Afternoon ; as it doth
C. *Bajador*, in reſpect of the *Canaries* : A
contrariwiſe, from the *Weſtward ſetting* Floo
ſubſtracts the ſame Space of Time, by h
Tendence to the ſame Point ; ſo as to make
flow at XI, at *Manomy-Point*, inſtead of X
that, as the Southing *Primary* Flood, at C. *B-*
jador, preceded the *Secondary* III at the *Ca-*
ries, at *three Hour*'s Diſtance ; ſo may the *P-*
mary VIII $\frac{1}{2}$, at *Gay-Head*, correſpond to
Secondary XI$\frac{1}{4}$, at *Manomy-Point*, to an Inſta

§.

So exact is the Accord of the *Primary* Ti
of this Sea, as to reach their Summits *e-*
where at once, by *Libration* ; and their *Secon-*
ry ones, which ſwell by *Undulation*, flow

equal a Time, around their Circuits: And th Sorts, obſerve as perciſely a *three Hour's* ſtance from each other, between their *rthern Tropick*, and the *Artick Circle*; as I ve demonſtrated: And, to evince, that they ld as ſtrict a Correſpondence, both as to *me*, and *Place*, with thoſe on the *other* Side their common *Axe*, between the ſaid *Tro-* k and the *Equator*;

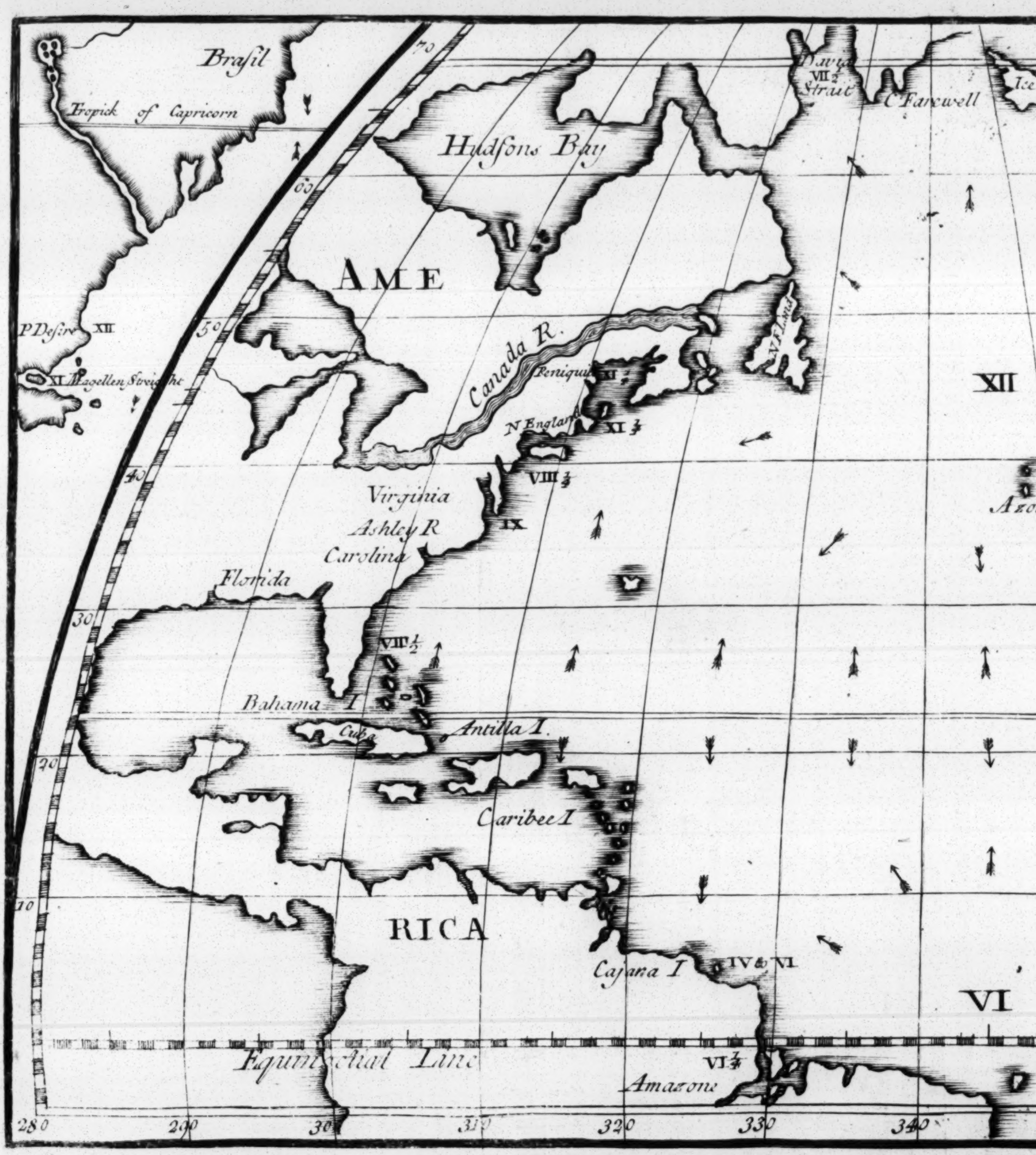
First, concerning the *Primary* Sort: Where- the Water flows upon the *Central Me- ian* of this Tract of Sea, about *twenty-three* grees Latitude, on this Side of the *Tropick*; s anſwer'd by VI, upon the *ſame Meridian*, ere it Interſects the *Equator*; not far from *Cajana*, where the Tide makes at VI: And he Mouth of the *R. Amazones*, a Quarter an Hour later; which correſponds, by *nter-Libration*, to XII at *C. Bajador*, to VII$\frac{1}{4}$ *Carolina*, and VIII$\frac{1}{4}$ at *Gay-Head*, *&c.* as a- eſaid, at the *ſame* Time; tho' *diverſly* deno- nated by the Moon's *different* Aſpect to ſe *three Places*, at one and the ſame indivi- l Inſtant.

Next, as to the *Secondary* Tides, which are ected from the *Primary* XII, on the Cen- of the *Atlantick*, towards the *Eaſtern* and *ern* Shores; the III^{s}, deſcribed on the *ern* Promontories of *Europe*, and *Africk*, his *North* ſide of the *Tropick*; are anſwer'd X^{s}, on the other in the *South*; at *C. Blan-* and *Sierra Leone*: As the XI^{s}, along the *ern* Coaſts of *New-England*, are, by the inſtead of V$\frac{1}{4}$, at *Surinam* (if it had lain n *equal* Diſtance from the ſaid *Meridian*):

To anſwer the ſaid XI^{s}, at *ſix Hour*'s End ; *vi* As at the *former* Place, near an Hour befo the Moon's *Southing* ; ſo at the *later*, as lon before her *Setting* ; to make their Returns *f* *hourly*, from each Side of the *Tropick*, alte nately ; whether they be of the *Primary* Sor made by *Libration* ; or of the *Secondary*, whic are deflected from 'em by *Undulation*, at *th* *Hour*'s Diſtance ; and happen ſo much later.

Such is the *general Accord* of theſe Tides, all *Places*, and ſo mutual is their Correſpo dence of *either ſort*, amongſt themſelves, each Side of their *common Axe* : And their M tions are ſtill ſo proper, and fitly adapted the *Places* aſſign'd ; and their Performances diſtinct, and purſuant to each other, th they muſt neceſſarily depend upon ſome *U* *verſal Cauſe* : And ſtill keeping as exact Tou with the *Courſe of the Moon*, in all Caſes ; a moſt reſenting her Preſence, by ſtoopi *loweſt* to it ; and the Water mounting *hig* in her Abſence, by *Rebound* alternately ; Preſſure muſt *firſt cauſe* them, and their o weight *Advance*, and *propagate* 'em afterwa by *Libration*, and *Undulation* (as aforeſai in the wide *Ocean* : But, leſt the great Div ſity of their Performance, in this moſt *irr* *lar* and *unaccountable Sea*, ſhou'd ſeem parti larly to *obſcure* this great Truth, and *r* *Doubts* to the contrary ; I ſhall endeavou clear 'em all off, one by one, in the foll ing *Section*.

SECT.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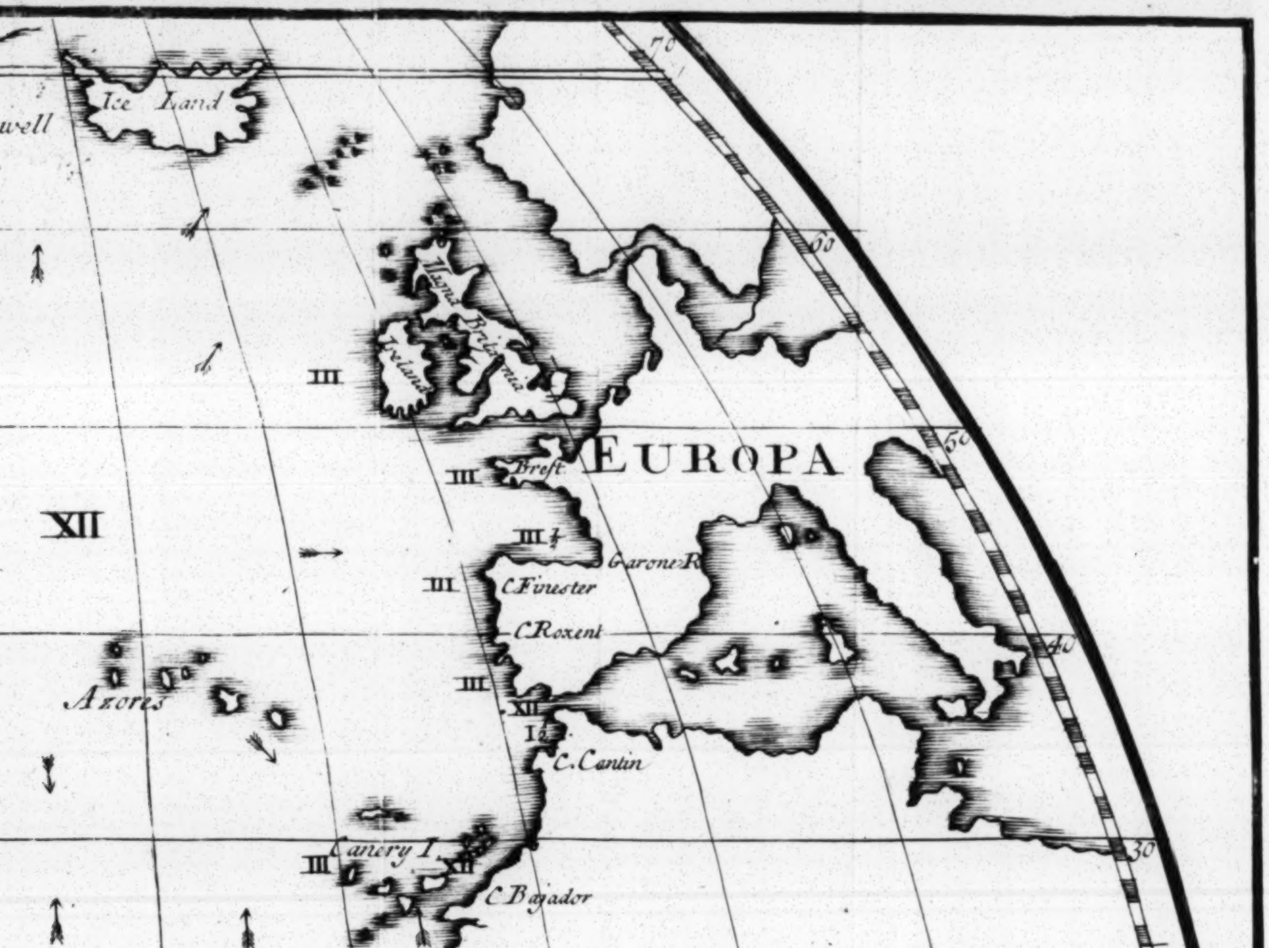

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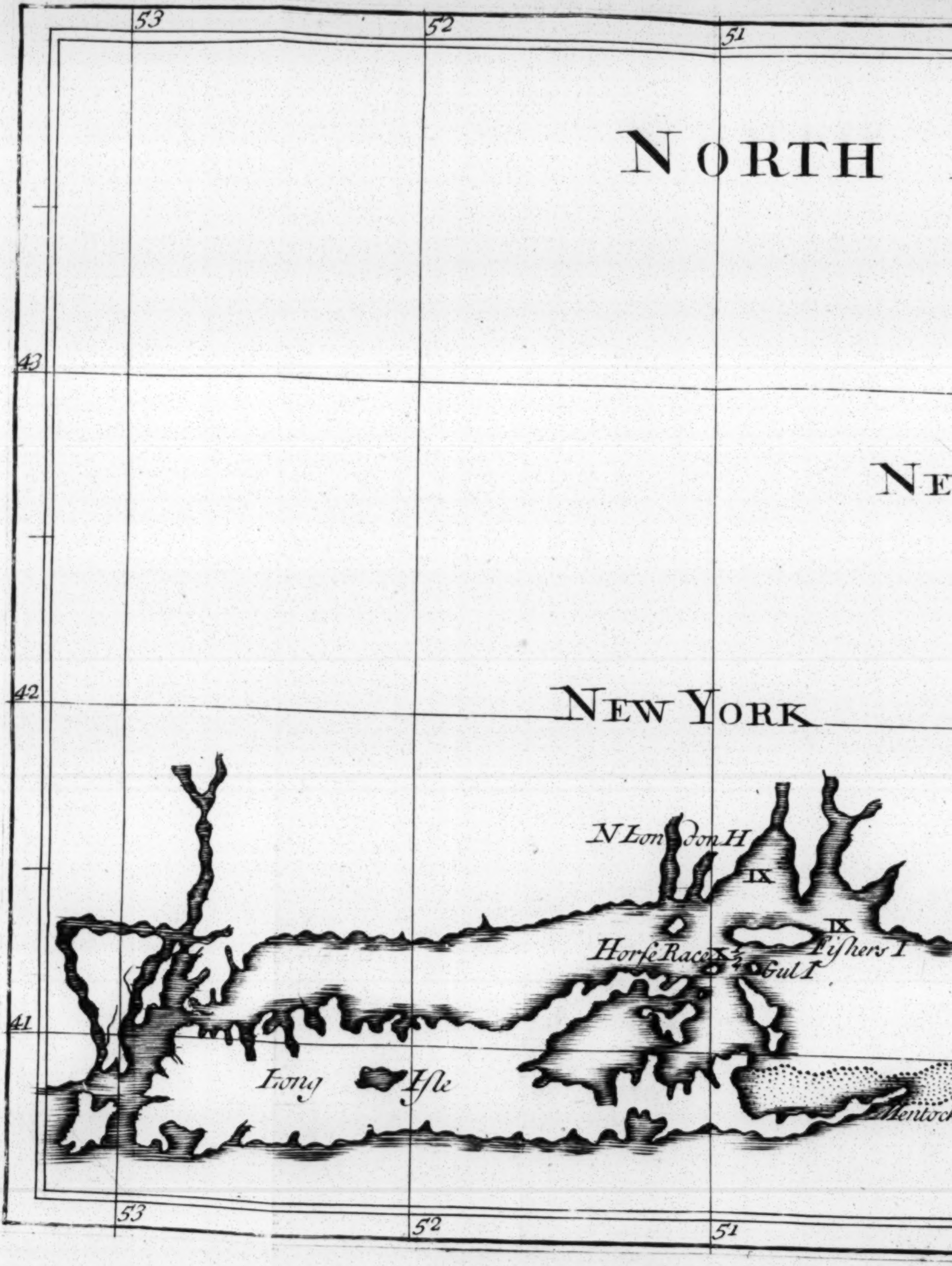
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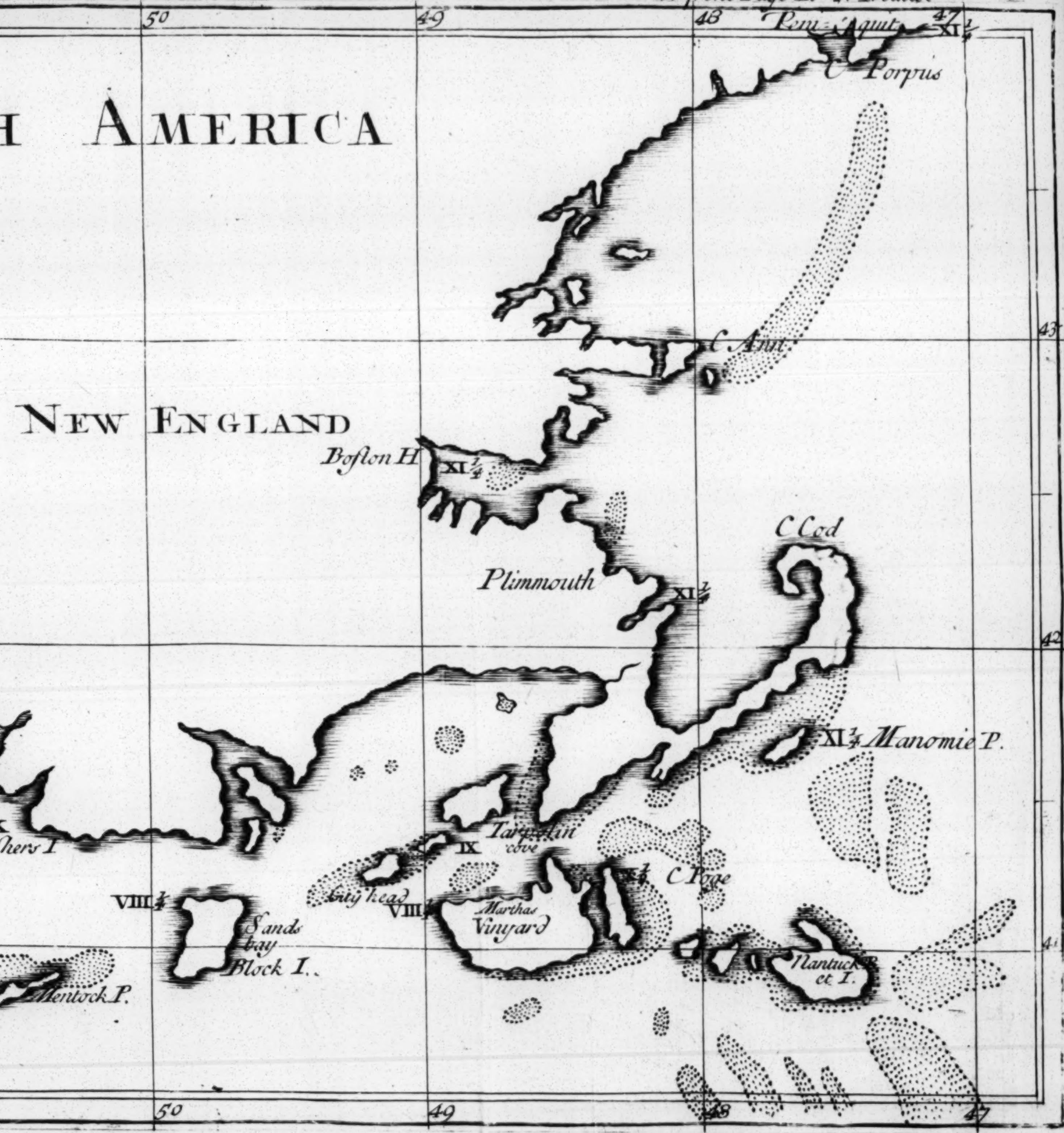

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S E C T. VI.

ſeeming Irregularities *of the* Atlantick Floods, *examin'd, and clear'd.*

IRST, Whereas it may be *objected*, that the *Atlantick Ocean*, being of no regular gure, cannot admit of a *Center* in the icteſt Senſe, more than any Conick Section, *Circle* excepted: *Anſw.* What I aſſign, is ly ſuch a Point, or *Place*, as ſeems to be oſt regarded by the Tide's *Diffuſion*; as ſpreading itſelf from thence with moſt *Equality*, to- rds the ſurrounding Shores.

2dly, That no *one* Place ſeems aſſignable, hence the Tide can poſſibly ſo affect the id Shores, as to *make at once*, on the *Weſtern* omontories of *Ireland*, *France*, *Spain*, and *tugal*, whoſe utmoſt Points lie almoſt in a *ct* Line, for near *five hundred Leagues* toge- er: *Anſw.* Yet, that Part of the *Atlantick*, hich is affected, being partly *Triangular*; d the *Tropick*, which is the *Axe* of the Tide at affects it, being its *Baſis*; a Tumour of e ſame Figure, and ſuch as the *American* hores, on the one Side; and the *European*, d *African* on the other, will admit; and hich is form'd, as in a *Mould*, by their Re- ption; is ſufficiently accomodated to com- eat the Work, at near the *ſame* Inſtant, on l the Shores aboveſaid.

3dly, To urge this Difficulty farther; it ems not practicable for the ſaid Tumour, to ach the *Bottom* of the *Bay of Biſcay*, even to e Mouth of the *Garrone*, as ſoon (within

half an Hour) as it affects the *extreme Po*
of the ſaid Promontories, which ſhoot the
ſelves forward near *three hundred Leagues* f
ther into the Ocean : *Anſw.* And it were
ſolutely impoſſible, for it to be hurried w
ſo great *Celerity,* from the Top to the Bott
of that *Bay* ; did not the Sea, within th
Promontories, run the *higheſt* ; and con
quently the *deepeſt,* to make way for it, of a
other on the Coaſts of *Europe,* or elſewher
(that one, near the *C. of Good Hope,* excepte
And, on the contrary, were not the ſa
Promontories fronted afar off, and *guarded*
ſhallower Water, and *ſhelvy Bottoms,* from t
haſty Approaches, and Inſults of thoſe Ti
Tumours, they muſt neceſſarily be flood
ſooner, than they be at preſent.

4*thly,* Yet be the Conveyance of dee
Water, as *ſpeedy* as it will, the *Central* Flo
of the *Atlantick,* cannot be diffuſed to t
Sreight of Gibraltar, by Anticipation ; as ſo
as the Moon *Souths* upon it ; which happ
an *Hour* and a *half* before the Sea be full, u
on the Great Meridian : *Anſw.* To this it
reply'd ; that the Moon brings along with h
thither *another* Flood, by her immediate Pr
ſure upon the *Mediterranean* Sea ; which,
its Occourſe with the *Central* Half-Tide of t
Atlantick, jointly ſwelleth the *Streight's Mo*
higher, than can be poſſibly done, after t
Mediterranean Tide's return towards the *L*
vant ; whence it came.

5*thly,* When it is urg'd ; That at *C. Bajad*
on the Coaſt of *Africk,* between the ſa
Streight and the *Tropick,* the Water alſo flo
at XII, tho' it has no Communication wi

th

e *Midland* Flood, to haſten it ; nor can it oceed ſo ſpeedily from the *Central* Tide of e *Atlantick*, at ſo great a Diſtance from it : *ſw.* Nor is it requiſite to flow from *either* of n ; or partake with 'em ; more, than to be o ſupply'd, immediately with Water, from *thin* the *Tropicks* ; and by the ſame Tidal *dulation*, which repleniſheth the reſt of the *lantick*, and at the *ſame* Time ; having its oper Channel, between the *Canary Iſlands* and e *African* Shore, to convey its proportionate rt of the Stream all along, from the *Equa-* , thither ; as ſoon, as to any other Part of e Sea ; and by Inclination of the *Shores* on oth Sides, to raiſe the Tide there *an Hour ner*, than at the Center of the *Atlantick* itſelf.

6thly, If it be ſtill inſiſted on ; that, to the ntrary, about *Cape Cantin*, near the Middle the ſaid Shore, between the ſaid *Streight* nd *Cape Bajador*, (upon both which XII is fix'd) it flows not 'till I½: *Anſw.* It is not be wonder'd at, that the Flood ſhou'd come much *later*, to the *Middle* of that Coaſting urrent, than to both the *Ends* thereof, upon hoſe Floods it jointly depends ; as being the roper *Cauſe*, whereby it is produced ; and onſequently it muſt ſwell *later*, and not withraw itſelf again, 'till after their Departure.

7thly, If the Tide ſeems to be either too *uick*, to make at *Cape Bajador* at XII ; or too *ow*, not to reach *I. Canary* 'till III, afterwards : *Anſw.* At the former Place, it is furniſh'd with Water immediately from the *Equa- or* ; and is withall, accelerated by *inclining Shores* : Whereas, at the later, it expects the Defluxion of a *Secondary* Flood, *three Hours* *longer*, from the Center of the *Atlantick*, which it lies expoſed.

8*thly*, If it be objected; that, at C. *Blan* it makes *ſix Hours* later, than at the ſaid *Iſle* to wit, at VI; tho' both lie in the *ſame Degr* of Longitude; and in Latitude not above Degrees diſtant from each other: *Anſw*: It because they lie on *different* Sides of their *Ax* and ſo are *counterpoſed* to each other, at Hours Diſtance, tho' they lie ſo near together

9*thly*, Yet it does not appear, why *Sier* *Leone* has two *diſtinct* Tides, the one at VII and the other at IX$\frac{2}{3}$: *Anſw*. It is, becau they are derived regularly, from two as *di* *ferently ſituated* Oceans: The former from the *Ethiopick*, and the later from the *Atlantick* and they correſpond each to their reſpecti Tides; the VII, being conſequent to that *R. Serbera*, which ſwells an Hour before i and the IX to the III^s, on the *Weſtern Promo* *tories of Europe*, &c.

10*thly*, At *R. Gojaven*, 'tis Tide *two Ho* *ſooner*, than at any other Sea-port, on all th ſame Coaſt: *Anſw*. 'Tis, in regard *Cape Pa* *mas* over-ſhooting the reſt, *drives* the Curre of the Sea into the Mouth of the River, wi ſo much Precipitation, as to *haſten* and rai the Tide, at their *joint Appulſe* to the Shor to a *greater* Height, than to be kept up an longer to the ſame Pitch.

11*thly*, The Water floods twice, at *I. Caj* *na*, at two Hours Diſtance: *Anſw*. That is ſay, *once*, being *over-haſtily* ſwell'd, like th at *Gojaven*, by the *joint Appulſe* of the Floo and Current, to the Shore ſo much too ſoon and the *ſecond* Time, not before the regul Hour.

La

Laſtly, The Flood at *R. Gabon* at VI, anti- tes thoſe on our *Weſtern Promontories*, which l not 'till the third Hour, after the Moon's hing upon 'em; and ſhou'd happen at to correſpond with the III^s at the C. *of Hope*, beyond the *South Tropick*, at ſix rs Diſtance: *Anſw.* The Parity holds not, double Account; this Flood at VI, be- *Primary*; the Stream which ſupplies it, ves to the *North* and *South* Shore, which out into the Ocean to meet it: Not a *Se- ary* one; to expect the Moon's paſſing for- ds two Hours, and the Flood's Return to the Shore in the third Hour, before it poſſibly happen.

fter all, if it be *queſtion'd*, why *R. Gojaven*, *n*, *Rey*, and *Monamba*'s *Hole*, each ſwell e in one Hour's Space, above the reſt of e Rivers on the ſame Coaſt. *Anſw.* 'Tis uſe the *Mouths* of the ſaid Rivers, are re- kably *reflected* towards the flowing Water; ch, being obliquely driven by a *ſtrong Sea- ent*, ſwells higheſt at its Appulſe to the oſitely reflected Shore, two Thirds of an r, before its Flux ceaſeth: And ſinking a le, after the Briskneſs of the Flux is over, *unts* again with the flowing Water, to tmoſt Pitch; the Top of the Tumour be- as it were, divided into *two Half-tides*, re it paſs into an Ebb.

ut, to caſt an Eye of Reflection upon the *ern Shores*; the Appearance of *Irregulari-* eems, at the firſt Sight, to exceed all our 'd Obſervation; *viz.* That an *E. S. E.* on ſhou'd make at *Florida*, at VII$\frac{1}{2}$; along *Virginean* Coaſt, a *S. E.* at IX; and a *S. E.* E. at VIII$\frac{1}{4}$ at *New-England*: But, upon a

ſecond Inſpection, ſubtract *one Hour's Ac*
ration from C. *Florida* (*Virginia* being regul
and *another* from the Account of *New-Engl*
and at the *Firſt* Place, it makes at VIII;
the *Second*, at IX; and at the *Third*, at IX
Which agrees exactly with the Moon's *diffe*
Poſitions to the *Declivity* of thoſe Shores:
as to adjuſt the Tides, at all thoſe *Three Pl*
to the *ſame* Time.

CONCLUSION.

Having *examin'd* the various Appearance
the Tide, in our *Weſtern Ocean*; and *clear'd*
ſeeming *Irregularities* of the *Atlantick* Part,
ſpecial Manner; which, for Multitude and
verſity, muſt exceed *all* that are incident to
other Diviſions of that Wilderneſs of W
which encompaſſeth the *Univerſe*; as muc
the *Anomaly* of its Figure, and the *Unacco*
bleneſs of its Situation ſurpaſſeth theirs:
this, with regard to the ſole *Efficiency* of
Sun, and Moon, by Means of their com
Inſtrument, *Preſſure*; proceeding conſta
from the *Cauſe* to the *Effect*:

Now, upon my Departure from the
Ocean, to our *narrow Britiſh Seas*, I am, *è*
verſo, to argue from the *Effect* to the C
that is, from the inextricable Maze of C
nels, and *Currents*, and the *confuſed Scene* of
dal Occurrences, which it exhibits, not t
parallel'd: That, upon a clear and mani
Diſplay, they are all *reconcil'd* amongſt th
ſelves, with that Perſpicuity, as to exclude
reaſonable Doubt to the contrary; and
they are all conformable to the ſame Ord
Nature, and Laws of Motion.

CH

CHAP. IV.

f the Tide's Reception into our Iriſh *and* Britiſh *Seas.*

TO give the Motion of the *Tide* a ſucceſſive Deſignation, in both the propos'd reſpects; Firſt, as to the *Place* whence it is to be drawn, it is the Center of the *Atlantick* *ean*; where it is rais'd by *Libration*, and ells alike by *Reſult*, from the New and Full-oon's Preſſure; but is not full Sea there, l they have attain'd to their Meridional eight between the *Tropicks*; and ſo cannot ach *Ireland* by *Undulation*, 'till after their uthing: Hence the Primary Full-Moon, Secondary New-Moon Tide, which makes *Midnight*, and uſually viſits the *Weſt* of *and*, at III, and the *Weſt* of *England*, at IV the Morning; and is call'd the *Day-Tide*; s moſt opportunely to be made Uſe of, as maining under our conſtant Inſpection, m Morning 'till Night.

This Secondary New, or Primary Full-oon Tide, no ſooner viſits the *Weſt* of *Ire-d*, but divides itſelf by *Fluctuation*, or a ved Flux of Stream, into *N.* and *S.* Floods; each Stream ſub-divides into Two more: e two *innermoſt*, including the Principali-of *Ireland* only, re-unite themſelves at the *of Man*; while the other Two *outward-*

bound Ones do the like at *Hull*, after they hav encompaſs'd *Great-Britain* alſo: Hence, its Motion appears to be every where progreſſive, a to its *Main* Courſe; and moſt *Regular*, wher it is remoteſt from Coaſts and Shores, eithe to deflect its Current, or retard its Speed Yet, as to the *Manner* of its Progreſs, it becomes almoſt every where very *different*, i ſome other reſpect: So that every *Branc* thereof is to be traced along its reſpectiv Stream, apart; and firſt down the Middle o the *Channel*, where it is leaſt Obnoxious t ſuch Impediments.

SECT. I.

The Tide's Diviſion, by ſundry Channels; *its Pr greſſive Motion, thro' as different* Roads; *wi Regard to the* TIME *and* PLACE *of Hig Water.*

TO begin with the *Engliſh Channel*, whi lies neareſt to our Inſpection, and b deſerves it, both for the Multiplicity and V riety of its Appearances; and trace its Cou from the Promontories of *Ireland* (where makes, on the *Weſtern* Coaſts, at III; and the *Southern*, at IV in the Morning), and f low it thence (as the *Arrows* in the Map rect), towards the moſt *S. Weſtern* Point *England*: It ſwells, over againſt *Falmo* near the *Lizzard*, about V; and paſſeth *Plymouth*, the next Port to it, at VI; and down the Middle of our Channel, bef

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Dartmouth, at VII; *Portland*, and *Weymouth*, at VIII; by the *Iſle of Wight*, at IX; 'till it reach *Dover*, at X and $\frac{1}{2}$: And having paſs'd the *Streight*, and left *Calais* after XI, it comes to *Dunkirk*, on the Netherland-ſide, about XII; paſſeth by *Goree*, at I and $\frac{1}{2}$; and before the *Maes*, at II $\frac{1}{4}$; and reacheth the Clifts of the *Texel*, at III and $\frac{1}{4}$; ſtill following the Direction of the ſame Shore, all along the *North* Sea, or *German* Ocean.

But deflecting thence towards the *South* Sea, which lieth before *Amſterdam*, thro' the Streights of *Texel*, at VI; and of the *Fly*, at VII; and following their ſeveral Channels, along the Coaſt of *Friezland*, 'till VIII; they conjoyn into one, at IX; which paſſeth by *Horn*, at XII; comes to *Amſterdam*, at III; and arrives after ll at *Harlem*, where it finiſheth its Courſe, at X: So *regularly* Progreſſive is the Tidal-Flood own the Middle of our *Engliſh Channel*, and long the Coaſts of *Flanders* and *Holland*; and o punctually are its *Stations* ſet down, on each ide; where Ports, as it were *Land-marks*, oint out what Way its Tumour makes, even o an *Hourly* Performance; on Our Side, from e *Weſt* of *Ireland*, as far as *Dover*; and on heirs, from *Calais* to *Amſterdam*.

And, to retutn to the Weſtern Coaſts of *land*, whence the *Northward-bound* Divi- n of the aforeſaid New and Full-Moon ood departed, at the ſame III Hours; it ived to the Weſt Side of the *Orcades*, at IX the Morning: But being to encompaſs al- the *Shutland Iſlands*, at *two* Degrees farther rth; and withal to ſwell the *whole Extent* Sea, between the Coaſts of *Norway* and thoſe *Iſlands*, before the Flood cou'd be reflected thence, and reach the ſame Height on the Eaſt Side of the *Orcades*, it arriv'd not Thither 'till III in the Afternoon: Nor did it affect the Road before the *Fair Iſle* (which lies betwixt 'em) 'till about XI; (which is their *Mean* Time,) as is found by Experience.

But to continue the ſaid Flux of the Tide from *Fair Iſle* Road, where it ſwells after XI, down the *German* Sea to the *Dogger*, where it meets with the *South* Flood, and incorporates with it; It is to be obſerv'd, that it exceeds not XI and ½, along the Coaſt of *Norway*, 'till it have paſs'd the *Naze*; and ſo continues to make at XII, or thereabouts, along *Denmark* and the *Jutland Iſlands*, 'till it reach the *Elbe* at the Eaſt-end of the ſaid Bank: And as th Tide makes not, on the *Shore* of *Fair Iſle*, 'til about III in the Afternoon; that is, *four Hou later* than it does in the *Road*: So upon th Coaſts of *Scotland* and *England*, it continu to make ſo much *later*, than on the opposit Shores of *Norway* and *Denmark*; that i either at, or after III, on the *Forelands* both Nations; 'till it reach *Flamborough-He* about IV, over againſt the Road aforeſaid.

Now it is remarkable, that, altho' th Flood paſſeth along *Norway* and *Denmark* a ſtraighter Coaſt; and withal according its firſt Direction, from within *Fair Iſle* Roa And, on the contrary, is conſiderably fleфted from it, towards the *Scotch* and *Engl* Shores; yet its Courſe to *Doggerbank* is patcht, on both Sides, at the ſame Rate; wit, on the Former, between XI and XI

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and on the Later, between III and IV; that is, within the Space of *One Hour*, on either Side alike: Hence it muſt be concluded, to do the ſame down the *Middle* Stream (where it meets with no Impediment); and to make upon the *Middle* of the ſaid *Bank*, at XII; and perhaps ſomewhat ſooner at the *Eaſt* End of it, and later at the *Weſt* End; or rather, in regard that the *South* Tide meets it briskly towards the *Weſt*, and decays afterwards; 'tis *Full*, all along from the one End to the other, at the ſame Time.

Having thus diſclos'd the *Place* of the Congreſs, of the *N.* and *S.* Floods, to be the ſaid *Sands*; and the Time to be at XII, by the Length of their Courſes thither, in both reſpects: It is farther manifeſt, that they joyntly rais'd the ſaid *Bank* as a Barrier, to break their mutual Inſults upon each other; and that the *Elbe*, *Rhine*, *Maes*, *&c.* brought down their Wreck from *Germany*, *Switzerland*, *France*, *&c.* which compoſeth it; being not a Work of the *Creation*, but a Heap of *Mudd*, waſht, by the beating of their Waves, into a *ſandy Bank*; planed on all Sides, into a rectilinear oblong Figure, by the *Streams* which laid it there, to cover the Coaſt whence it came; and that it became *ſeparated* from the Land, by the Interpoſition of the *South* Flood, which ſtruck in betwixt it and the *Netherlands*; and finally, was parted at each End, from the *Engliſh* and *German* Shores, by Channels made by the the *North* Tide; which ſloap'd off its nether Corners, to leave a free Communication betwixt their Streams: As the greateſt *Rivers*, when they caſt up Banks of Sand, to ſecure their Ports, commonly keep *more* Channels open than one, to diſembogue their Floods with more Freedom into the Ocean.

So conſtant and regular is the progreſſive Flux of the Tide, down the *Middle Stream* of its Channel, around our Coaſts: Let us ſee what *Rubs* it meets withal near the *Shores*, to hinder its Paſſage, or deflect its Courſe into ſo great a Diverſity of Motion, as to be otherwiſe unaccountable.

SECT. II.

Obſervations and Reflections upon the Diviſion, *and* Progreſſion *of the Tide, deſcribed in the precedent Section, with regard to the* Shores.

TO begin my Reflections on the *Weſt* of *Ireland*, where I firſt enter'd upon the ſaid Deſcription; it is obſervable, that the Tidal Flood found a *free* and *open* Paſſage before the *South* Coaſt of that Kingdom, 'till it enter'd the Chops of our *Engliſh Channel*, between *Uſhant* and *Silly*; and held on its Courſe to the *Eaſtward*, down its *Middle* Stream, at almoſt the ſame Rate, of Time and Place progreſſively, from the *Lizzard* to *Dover*, the Coaſt being favourable, and its *Forelands* lying almoſt in a direct Line; and the *Bays* betwixt 'em being ſo little depreſs'd, as to give it no conſiderable Stop, or Deflection for at leaſt a *hundred Leagues* together.

Whereas, on the contrary, it is no leſs remarkable, that athwart the *South* of *England* beeyond the Channel, on the *French* Side; hat Tract of Sea, which correſponds to urs, is divided into *Two Bays*, or *Gulphs*, of a arge Extent; the One, reaching from *Uſhant*, o *Cape Hague*; and the Other from *Cape Barfleur*, to *Calais*; which break the Courſe of he Flood, on that Side, as it were into *Starts*, rom one Head of Land to another: And ertain ſeveral *Rocks*, and *Iſlands*, which ofen ſtop, and ſometimes force the Flood to *ecoil* whence it came; after they have raiſ'd ts Tumour to its full Height, two or three Hours ſooner than ordinary.

The firſt *Rub*, that this Eaſtward Progreſſion f the Tide meets with, is the *Weſtern Shore* of *Uſhant*; upon which, its Flux from the Ocean, falling, as it were, from a higher Sea nto lower Water, raiſeth, by Rebound, a greater Tumour, than to be ſupported by the Flood which brought it, any longer than the Dint of its firſt Impulſe laſteth; and by this means, makes at III and ¾ in the Morning, *wo Hours ſooner* than in the *Channel* it ſelf; which has the *Gulph* below it to fill, before it can arrive to its full Pitch, at VI: And the like happens at *Garnſey*, ſome Leagues down he Current; where, to the Sea-ward, it makes at V and ¼; yet, in paſſing down the Channel, not 'till IX and ¾, full *three Hours ter*: And it muſt do the like, at all other Places, which *confront* the Flood, to ſet it on; nd are *flank'd* by Channels, to carry it off gain.

After the Tide has paſs'd the *Uſhant*, the ext *Rub* that falls in its Way is the *Normand romontory*; which dams the Stream on that

Side, tranſverſly, from *Cape Hague* to St. *Malo's*, which lies in the Bottom of the Bay where 'tis Flood at V and ¼, and the Higheſ perhaps in *Europe*: ſo that it both precedes an exceeds That in the Channel at *Uſhant*, whence it Flows; tho' at *twenty Leagues* diſtance from it; which ſeems ('till both be well conſider'd) to make the Effect to anticipate, an ſurpaſs the Cauſe that produc'd it: And th like muſt happen, proportionably, upon a that *Coaſt*, from the *Cape* to the *Port* aforeſaid and conſequently co-extend to the *Gulph*, a long the *French* Shore, from *Uſhant* thither.

But the Flood having paſs'd thorow th Streight, between the ſaid *Cape* and the *Star* down its common Road; while it ſlips b *Portland* at VIII, the *Iſle* of *Wight* at IX, an reacheth *Dover* at X and ½, it ſpends all th Time in doubling the *Cape Barfleur*, before arrives at the Road of *Caen*, where it mak at X and ½: And continues to do the like the ſame Hour, all along the Coaſt of *N* *mandy* and *Picardy*, from before *Caen* down *Calais*: The Lines of the Tide's Diffuſi from its *direct* Courſe, to thoſe *Tranſverſe* i clining Coaſts, growing ſtill proportionab ſhorter, and conſequently ſupplying 'em wi Water ſo much quicker; 'till their Diſtanc both in Time and Place, be concenter'd in Point, at the Streight between *Dover* and C *lais*; ſo as to render the Making of the Tid along thoſe Coaſts, with regard to its *Eſt* Courſe, inſtantaneous.

And from the Streight at *Dover*, the Sea full before the *Downs* and *Harwich*, as far *Yarmouth* Road, at the *ſame* Hour that it Flo

the Coaſt of *Normandy* and *Picardy*, for a-
e *ſixty Leagues* together; tho' it be *diverſly*
aſion'd: Becauſe, along thoſe Provinces of
nce, the Shore ſo *inclin'd* towards the *Mid-*
Stream (which ſwell'd ſucceſſively) that
farther they went, it was proportionably
quicker ſupply'd: But here, upon the
aſts of *Eſſex*, *Suſſex*, *&c.* the Flux of the
des, being partly reſiſted by the *Sands* be-
e *Yarmouth*; and partly repuls'd by the *Oc-*
ſe of the Northern Flood, ſwells equally
oth Ends, and thro' all the intermediate
ct of Sea, *at once*; as alſo upon the ſame
ct Line, as long as the Water riſeth at
er to ſupply it; that is, for *five* or *ſix*
rs Space; to make High water all along,
m *Caen* in *Normandy* to *Yarmouth* in *Norfolk*,
he ſame Inſtant.

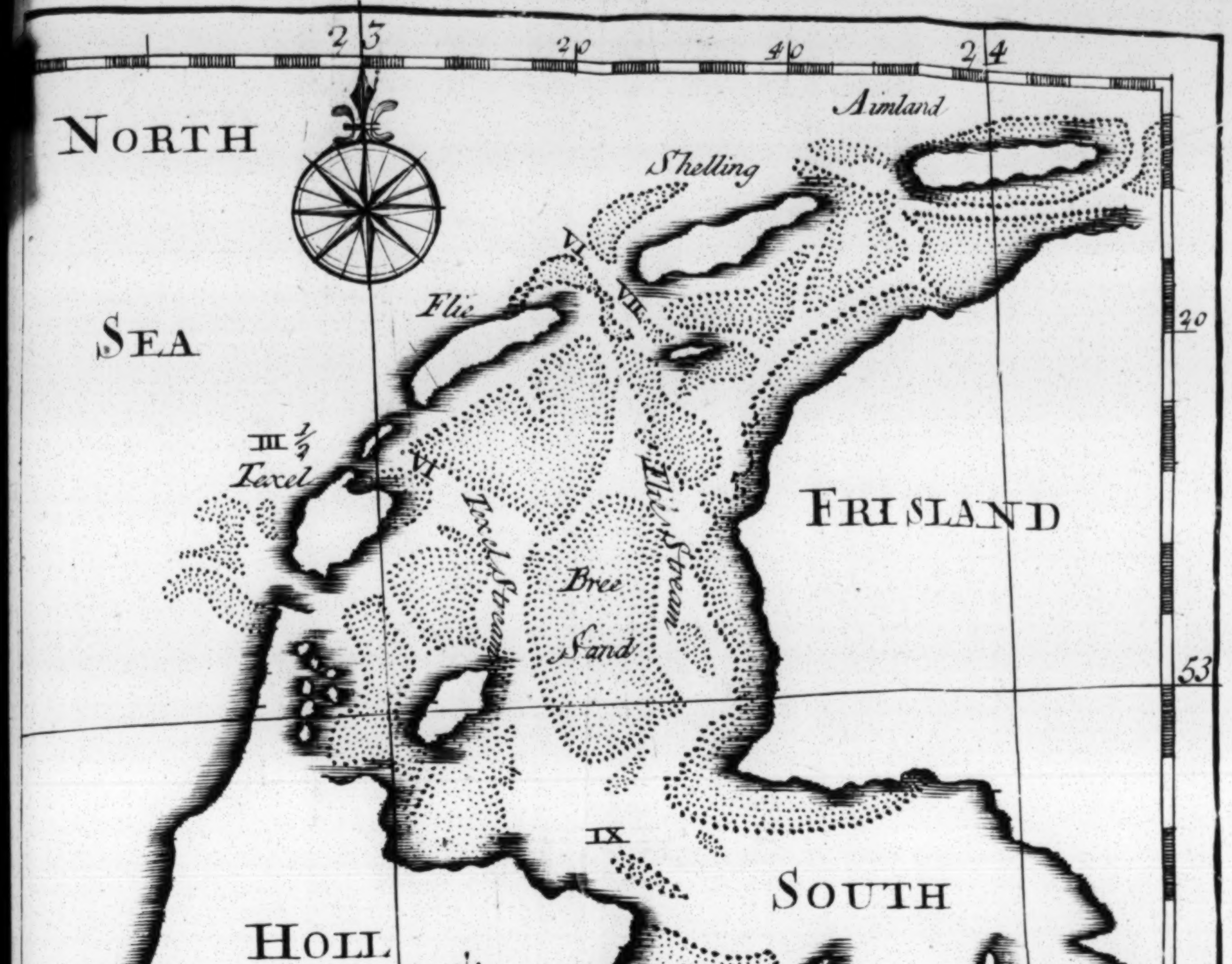
nd when the North and South Tides meet
rwards upon the ſaid *Sands*, at XII, and be-
e united into One; it is after ſuch Man-
, that altho' their joint Flood co-extends
e whole Coaſt of *Flanders* and *Holland*, at
ſame Hour, on the *Road*, ſo as to fill All
, at once; yet it creeps progreſſively up-
the *Shores*, for *five Hours* together; that is,
m *Calais* about X in the Morning, to *Texel*
r III in the Afternoon; as I have already
ribed; each Flood, notwithſtanding their
junction, perſiſting to produce its ſpecial
ct: For, in regard the *German Sea*, opens
Mouth wide enough towards the *Northern*
n, to receive its Tidal Impreſſion in full
aſure; and is deep enough, to convey it
rely to the *Digger-bank*; and continues to
ſame Breadth, to comprehend it all at
once;

once; 'tis proportionate, in every reſpe to effect it *All* at the ſame Time, eſpeciall being *directly* objected againſt it: And it no leſs proper for the *South* Flood, inaſmuc as it is ſharpen'd by the Streightneſs of its Pa ſage, at *Dover*; and withal, directed towar the *Netherlands*: To continue its Flux at competent Rate, along their *Shores*, in com pliance with the Impulſe and Direction afor ſaid.

After all, this Coaſting Tide ſets, from th *N. Weſt*, upon the Clifts of the *Texel*, at I Afternoon; and at IV, at the *Fly*; y makes not *before* them 'till VI and VII Night; being deflected from its *Eaſt* Courſe, into the *South* Sea: And withal, b ing almoſt ſpent by paſſing over the San makes ſo little Way down their crooked a narrow Channels, on the Coaſt of *Friſela* and before *Horn*; that a ſecond Flood ſuccee this at *Texel* before it can reach *Amſterda* and *ſix Hours* e'er it advanceth to *Harlem*, finiſh its Courſe; as 'tis delineated in t following Map of *Holland*.

Such is the Speed and Regularity of t Flood, in *direct* and *open Channels*, as I deſc bed in the laſt *Section*; and, on the contra it becomes ſo diſorder'd, and retarded by *flecting Shores* of *ſhallow* Water, as I demonſtr in this; the Tide flowing all the wh But *Why*, upon its Ebb, it ſhou'd make Hi Water in ſome Places, where it was Low fore, ſtill remains to be diſcuſs'd.

SECT.



To front Page 126. 2d Treatise

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SECT. III.

the Flux of One Tide *produceth* Another *its Reflux ; and that* One Flood *may become* Many, *by a diverſe Application to the ſame Shore.*

HUS far I have traced the *Courſe of the Tide*, as proceeding from the Ocean greſſively, either by a *direct*, or *deflected* h; and diſplay'd its ſundry *Appearances*, on accounts: But being found by Obſerva-, that its *Reflux* ſometimes raiſeth Turs, where the *Flux* had produced none be-; and all this while, no greater quantity Water was return'd by the ſame Channel ccaſion it; eſpecially it happening near time of *Low-water*, and after ſo odd a ner; that whereas in ſome places, the ing Flood only waſht the *Shores*, the reing Ebb ſpared them, and ſwell'd the *nel*; and in others, the Flood made Higher to the *Sea-ward-ſide* of the Iſlands, and Ebbing-water to the *Lee ward* afterwards: , 'tis Remarkable, that, in thoſe Caſes, *Inclining Shores* render'd the Tide, at its urn, ſo much more compact and forcible, *contracting* its Stream cloſer together, as perform the ſaid Effects.

or an Inſtance of the *former* Sort, it is rv'd to be High-water at *Dover* about X ½; and at *Calais* at XI in the Morning; in the *Straight*, or *Channel* between them, to [illegible] to the ſame Height, until III in a [illegible] upon its Stream's return from

the Coaſt of *Flanders:* For, whereas the C
rent, paſſing thro' the Streight aforeſaid,
tween X and XI, had free liberty, upon
Confinement, to mount *both Shores* at o
yet cou'd not riſe to its full Height in the C
nel, being carried off too ſpeedily, thre
veral Ways at once; *viz.* towards the *D*
Flanders, and *France*: But now at III, up
triple *Confluence* of all their Streams, in
Mouth of the ſaid *Streight,* it becomes ſw
up in the Middle, by 'em *All* at once; and
its Tumour is ſo buoy'd up from each S
by the *Occurrence* of the two adverſe Stre
from the *Engliſh* and *French* Side, as not t
it affect the Adjacent Shores.

Of the *later* Sort is the Tide at *U*
where it makes, by its Flux from the M
into the *Bay* towards the *Weſt* at IV and
the Morning; and yet is not full Sea,
its *Eaſt* Side, by its Reflux out of the Cha
till XII at Noon; the Stream, on its re
along the *Inclining Shore* of *Little-Britain,* b
more contracted, and haſten'd Thither w
than towards the oppoſite Side of the Iſ
where it flow'd before.

The like happens at *Garnſey,* which
ſituated in the Sea, upon *Cape Hague,*
Foreland of all *Normandy*; which, ſtra
ning the *South Channel* to the Half; m
the Ebb, at its return from the *Eaſt*
fill that Side of the Iſland full at XII a
that was empty before; when it Flow
VII, on the *contrary* Part: And the ſame J
ment is to be made of all other *Iſlands,* w
lye Open to receive the Flux of the T
on the one Side; and withal near ſom

cl

ing Shore, to contract its Reflux more In-
ſly, on the Other.

And upon *all* the aboveſaid Accounts, the
od affects the *Iſle of Wight*, on all Sides re-
ctively, at *different* Hours : Firſt, on the
t Side, as being directly oppos'd to the
ving Stream, the growth of its Tumour is
ſequently haſten'd by it, ſo ſoon as to
I in the Morning : Next, on the *South*
e, which lyes towards the Channel, the
le is carried off again by it, at IX : Then,
the *N. Weſt*, where the Tide and the *Race*
et on the backſide of the Iſle, before *Calſhot*,
Water is full at XI : After that on the *N.*
t, the Flood has at *Portſmouth* a Harbour
fill, which detains it till paſt XII : And
ally, it expects the Reflux of the Stream
of that Port, to meet the Ebbing Water
m *Winchelſea* and *Dover*, at full *Eaſt* ; to
ell on their Occourſe there, higher than
fore, about I and ½ ; having ſpent full *five*
urs ſpace, in ſurrounding ſo ſmall a ſpot
Ground ; which is near half as much time,
ſufficeth to do the like to all *England* and
tland, conjoin'd.

The like diverſity of Tides, is alſo found
affect *Capes*, *Promontories*, &c. upon their
ferent Applications; as the *Start*, *Flamborrow-*
ad, the *Lizzard*, &c. that are waſht by
warting Streams, which haſten their Tides
that Side, towards the Ocean ; till they
let off again down the *Channel*, and are
flected afterwards to the *Leeward* ſucceſſive-
, both to prolong their Continuance, and
peat their Tumours, by a *diverſe* Acceſs to
e ſame Place : As without *Calais*, to be
full

full Sea at I and ½; towards *Dover*, at III; i
Creek, at IV and ½; without the *Road*, at X
½; and at the *Peer*, at XII: Nay, ſomet
it is *Progreſſive* on one Side of a *Cape*, and ſ
Retrograde on the other; as when it m
at X before *Dover*, it advanceth two h
forward towards *Quinborrow*; and ſeemi
retires as many backward to *South-Ham*
to make full Sea at XII, with the South
Moon at both Places.

But in caſe thoſe *Promontories* &c. ſ
directly into the Main, as on the *Weſt*
of Ireland, where no ſuch Currents thwart '
the Tide affects 'em an hour ſooner, than
Bays within the *Capes*; and *Theſe*, an hour
fore the *Ports*; whereas it fills the *Rivers*
ceſſively ſlower, the farther they ſtrike up
the Land; as it doth all along the *South*
thereof; from *C. Clear* to *Waterford*: He
it is High-water in the *Road* at *Harwich*,
Hour before the *Port* be full; and two Ho
ſooner before *Tinmouth*, than it makes at N
caſtle; and three Hours at *Margate*, 'ere i
full Sea at *London Bridge*: And, whereas
flows on the *Downs*, at XII; at *Graveſend*
I and ½; and not at *London* till III; the F
Stage being *twenty Leagues*, and the Laſt
ten; and conſequently the Courſe of its F
grows *doubly ſlower*; Hence we may Co
clude, that it does ſo ſucceſſively to the E
of its Journey.

Finally, as to the Approach of the Tide
other *Coaſts*, which are *Bold*, and hold to t
ſame direction; 'tis both ſpeedy, and all alo
Conſequent to it ſelf, to a Moment; but,
the Shore prove either *rough*, or *ſhallow*;

brok

oken by *Rocks* and *Shelves*, its Acceſs be-
mes proportionably retarded; yet grows
t conſiderably ſlower, unleſs upon ſome
emarkable *declivity* from the Channel, which
pplies it; which is viſible to the Eye, and
ferable to the *Map* of the Place, without any
her Elucidation: So that having diſplay'd
e *Courſe of the Tide*, as rais'd by the Moon's
eſſure, between the *Tropicks*; and diffuſed
er the *Atlantick Ocean*, by the counterpoiſe
its own Weight, in the Two precedent
ps; and in *This*, having pickt up the chief
ubbs, objected againſt its Progreſs thro' our
itiſh Seas, and remov'd 'em out of its way,
to deſignation of *Place*, and computation
Time: It occurs to ſhew, how it becomes
verſify'd in *Height*, as well as *Speed*, both in
t *Narrow Seas* which it affects; and in the
can it ſelf, which produceth it.

SECT. IV.

brief Rehearſal of the moſt remarkable Occur-
rences of our Britiſh Tides, *already diſcours'd*
of.

Ince the manifold Diviſions of the Tide
in our *Narrow Seas*, and the great *diverſity*
f its Channels, have ſo deflected its Streams
very way at once; that no known tract of
ater, of the ſame Extent, ever branch'd it
lf into ſuch *variety* of Occurrences; that
ſeems to abridge all thoſe, that are any
here found in the *Ocean*, within ſo ſmall a
compaſs:

compaſs: I ſhall only recount a few, ou ſo great a Number; which are moſt *Rema able*, and explanatory of thoſe, which I ha contingently taken notice of, but not fu Explicated, elſewhere; referring the reſt the Inſpection of the *Map* thereof, where is drawn a Scheme, which repreſents 'em at one view; and exhibits to the *Eye* th Connection and conſequence more effectu ly, than *Words* can expreſs.

Firſt, One and the ſame Tide may af *ſeveral Ports* at once, tho' they lye all on *ſame Side* of the Channel, that ſucceſſiv ſupply's 'em; as along the Coaſts of *Norm dy* and *Picardy*, from *Caen* to *Calais*; or *Ports* be ſituated on the *Oppoſite* Coaſts; as the *Downs*, *Harwich*, and *Yarmouth*; upon which, it Flows all along at the *ſame Ti* tho' the Stream which ſupply's 'em, paſſ by 'em *ſucceſſively*, one after another, not at the ſame diſtance.

Secondly, the ſame *Tide* may, contemporal fill *far remote Ports*, by diſtinct Channels, they either lye at the *like diſtance* from Places, where their Streams were ſeparat as the *Iſle of Wight*, does from *Dublin*; *Rye*, from *Leverpool*; which are alike diſt from the *Lizzard*, where their Floods w ſeparated: Or, the ſame Flood may convey'd by two *oppoſite* Channels, *reflex'* the ſame Place, ſo as to make ſometimes one ſingle Tide, when they meet there; elſe two diſtinct ones, when they are dri by the Wind ſucceſſively thither; as at *Iſle of Man*; when the ſame Flood paſſ from the Ocean, by the *North* and *South*

Irel

reland, diverſly thither; while the ſame Tide
paſſeth, in like manner, by the *N.* of *Scotland* and *S.* of *England*, to *Hull*; and makes
ut one Flood there, at the remoteſt Diſtance
rom the Ocean.

Moreover, in regard the Courſe of the
Stream, while it flows in a *direct Line*, is perform'd with moſt Eaſe, and *greateſt Celerity*; and
very Deflection becomes a retarding *Impediment*: Hence, it is High-water an Hour ſooner
t *Briſtol*, than at *Bridgwater*, tho' it be much
rther diſtant from the Ocean, becauſe it lies
n a *directer* Line from it: And the Flood
wells two Hours ſooner at *Dover*, than at
ortſmouth, which it paſſeth by, becauſe it *deflects* out of its Road; and when it is arriv'd
ither, it finds a *large Creek* to be fill'd with
ater, which doubles the Impediment.

Beſides, the Flux and Reflux of the ſame
ide, being jointly perform'd in *twelve Hours*
pace, in all Places, how circumſtanc'd ſoever, according to the Stamp firſt ſet upon it
y the Moon's Preſſure, between the *Tropicks*;
et not ſo, as to be perform'd in *ſix Hours* apiece;
ut, by how much the longer the Flux is, the
eflux muſt be ſo much *ſhorter*, and on the
onverſe; according to the Capacity of the
annels which convey 'em, and the Situation of
e *Ports* which receive 'em: Hence, *Rivers*, tho'
pply'd by the ſame Flood, and cloſe together,
b and Flow at *different* Rates, and ſeldom at
e ſame Time; as *Marſey*, and *Ribble*: The
ter ſpends more Time in Flooding than Ebbing, and the Former does the contrary; as
nting that *Fall* of Stream, which the other
ver has, to diſcharge itſelf, as ſoon as the
ux is over.

And if the Places, affected by the Tide, lie in the *ſame* Tract, ſo as to be affected b it *ſucceſſively*, one after another; the differen of their Tides, is to be calculated from the diſtance of *Time*, not of *Place*: Hence it High-water at *Calais*, when it is Low-wat at *London-Bridge*, and on the Converſe; b cauſe it conſtantly ſpends about *ſix Hours* paſſing between 'em; and not becauſe th lie at ſuch a *diſtance of Place* from each oth ſince it alike affects *Amſterdam*, and *Harle* tho' theſe be not *ten Miles* diſtant, and th are near *thirty Leagues*: And in caſe their D ſtance either exceeds, or reacheth *twelve Ho* as the Tides do at *Plimouth* and *Hull*, or *Texel* and *Amſterdam*; they cannot be floo both *at once*, by the ſame Tidal Und tion.

Nor is it ſo ſtrange, that our *Engliſh Cha* the River *Humber*, and *Zuider Zee*, ſhou'd *once* make High-water, by *three different Ti* at ſo great a diſtance of *Place*; as that *Garrone* in *Gaſcony*, ſhou'd contain *Two* diſti Tides, and the ſaid *Zee* as many at o for *ſix hours* ſpace in *twenty four*; ev Tide ſpending *eighteen hours* in paſſing that *River* (as well as thro' that *Lake*) *twelve hours* diſtance, the one from the o making High-water in the *Mouth of the R* and at *Bourdeaux* at the ſame Inſtant, *different* Tides, the one ſucceeding the o at the ſaid diſtance; and the leading F ſpending *ſix hours* more, before its Courſe finiſht at St. *Macar*'s; yet fail not o their reſpective Returns in due time.

Thus the Motion of the Tide, which was firſt
mpreſs'd upon that vaſt Wilderneſs of water,
he *Ocean in general* ; tho' throughout *Homoge-*
eous, both for time and place ; riſing and falling
erpendicularly, upon the *Equator*, and alter-
ately, in *ſix hours* apiece ; when it was boun-
ed with *Coaſts* and *Shores*, the Tides became
iverſly deflected, by their *different Situations*,
om their former *Regularity* in both reſpects ;
appears by the more ſpecial Account, gi-
n of 'em within the *Atlantick* : And upon its
eception into our *Narrow-Seas*, new differen-
s in thoſe reſpects aroſe at every turn, into
ch a diverſity of Motions, and manifold
ccurrences, as I have already deſcrib'd.

Now, in regard it ſprung at firſt, from a
Feet and *Inches*, near the *Equator* ; to al-
ſt as many *Fathoms* in other *Places* ; I am
ſhew, in the ſequele of the enſueing *Section*,
at Advantage it makes of every ſtep it takes,
m the one Extreme to the other.

SECT. V.

the Tide's diverſity in HEIGHT ; *and how*
t is gradually encreaſed, both in the Atlantick
Ocean *which propagates it, and in our* Narrow
eas, *which receive it.*

O take the Dimenſions of the Tide, aright ;
and draw the Encreaſe of its *Height* and
d, from proportionate Depths of *Sea*, and
inations of *Coaſts* and *Shores*, along its Courſe
n the *Equator*, whence it has its Origin ; to

our *Ports*, where it terminates: I here re aſſume that *New-Moon Tide*, which I deſcrib in the *laſt Section*, for a *Pattern* to follow thro' the *Atlantick Ocean* into our *Narrow-Sea* and remark what advance it makes at eve ſtep, in either reſpect.

The Firſt Step, which the *New-Moon-Ti* monthly advanceth above the Ocean's natu Level, at the *Equator* (as we are told, from t Relation of a curious Obſerver) exceeds n *ſix Foot*; whereto the *Equinoctial* Flood, ſup adds not above *ſix Inches*: whereas at *Bri* here in *England*, and at St. *Malo*'s in *Fra* it reacheth *ſixty* and *ſeventy Foot*, as is fou by Experience: So that the Effect ſeems exceed the Cauſe, from whence it ſprings, a *Decuple* proportion: Now, to trace the ſ Steps in order, from the firſt to the laſt; a ſhew, from the Connexion and Conſeque of the whole *Series*, that they arrive only an *Equivalence* each to other, all Circumſtan being duly conſider'd;

Firſt, It is obſerv'd, that the ſaid *ſix Foo* Water, which, near the *Line*, is ſpread o all that Space of the Ocean, which exte from *Guinea* to the *Weſt-Indian Iſlands*, is co tracted by *Libration*, into half that Breadt the *Atlantick* Tumour; and conſequen muſt be rais'd double that Height, to rec pence in one reſpect, what it looſeth another; eſpecially being depreſs'd *perpe cularly* by the Moon, and in a more a Meaſure nearer the *Equator*, than elſewhe After that the Lines of her Preſſure are m *obliquely* and thinner ſcatter'd; to make *ſix* of Water there, more than equivalent to *twice Six*, at the Middle of the *Atlantick*.

Again, the ſaid Tumour, diffuſing it ſelf towards the *Coaſt of Europe*; That Part of it, which falls on the *Weſterly Shore* of *Spain*, and *France*, on the one Side; and on the *Southerly Coaſt* of *Ireland* on the other; becomes ſtill more contracted, to add *ſix Foot* more; and entring upon the *Soundings*, their ſhallow Bottoms ſtill advance it gradually, as they aſcend; to ſuperadd *ſix Foot* at leaſt, before it enters the Chops of our *Engliſh*, and *Iriſh Channels*; being contracted as well in Depth, as Breadth, ſo as to make its Total Elevation *twenty-four Foot*, or *four Fathoms* compleat.

Or, be the Tide, in its Paſſage between *Breſt* and *Kingſale*, advanced to what other determinate Height ſoever; yet all the ſeveral Floods of our *Iriſh* and *Engliſh Channels*, from *Dublin* to *Hull*; as alſo thoſe of *France* and *Flanders*, from *Breſt* to *Amſterdam*, muſt depend upon it as their *common* Source; ſo as to owe their Riſe *above* it, either to the advantageous Reception into their *Ports*, or to the favourable Conveyance of their *Channels*, thither; ſo as to mount ſome of 'em *ordinarily*, to *thirty* and *forty* Foot; and others *extraordinarily*, to at leaſt *fifty*, *ſixty*, and *ſeventy* Foot: But the Queſtion is, How thoſe *Ports* and *Channels* may be fitly diſpos'd for that Purpoſe?

The *firſt* advantageous Diſpoſition for a plentiful Flood, is, that the *Mouth* of the *Channel*, which intromits it from the ſaid general Source, be wide enough to fill up the

Ports which receive it, in due Time, befo
its Reflux takes it off again ; or elſe it fal
ſhort of the Height of the *common Tid*
which leaves the *Port* ſo unſupply'd, that
ſtagnates, in ſome Meaſure, into a *Lak*
that neither riſes ſo high, nor falls ſo low,
the *Sea* it ſelf at *Spring-Tides* ; while the *Nea*
Tides ſeem to ceaſe into Calm-water.

Next, to give the ſaid Aperture a conſid
rable Advantage, the *Sides* of the *Port* whi
receives the Flood, muſt mutually *incline* ea
towards the other, to contract its Tumou
as it were, *Pyramidically*, from the *Ba*
whereby it enters in ample manner, to
Vertex, where it is perfected ; that the Weig
of ſo much Water, put into Motion, m
ſtill puſh forwards its *gradually contracted* Strea
with more Violence ; to make out in *Heig*
and *Speed*, what it looſeth in *Breadth* : as
happens in the *Downs* ; which lie at abo
three hundred Leagues diſtance from the Oce
and are choaked up with the *Goodwin-San*
and withal invert the Current *Weſtward*, qu
contrary to its former Courſe, thro' the Cha
nel that convey'd it thither ; yet the *Bay*,
Vertue of its *Triangular Figure* alone, co
tracting itſelf into the Mouth of the *Tham*
ſends up the River a conſiderable Tide, for
leaſt *twenty Leagues* together.

Thirdly, Becauſe *quickneſs* of Motion a
an equivalent Force, proportionably to
Weight of the Water which is moved ; a
Projectils, are inclined to follow their *firſt* D
rection ; every *Deflection* from it, muſt t
to the Tide's Diſadvantage : Hence it is, t
the Mouth of the *Seine*, tho' it adds a *D*

pr

roportionate to its other Advantages, of *Ori-* and *Figure*, to furniſh Water enough for a ontracted Tide ; yet, being entangled by its erpentine *Windings*, to and fro, it advanceth ot up the River above *half* as far, as it doth up *arone* upon the *ſame* Advantages ; finding all long an *opener* and *ſtraiter Channel*, which carries it up into the Land *one Hundred* and *twenty iles*, without any Diſturbance.

But, to raiſe the Tide at *Briſtol*, remarkably above *all* the afore-mention'd ; beſides the id Advantages of *Breadth*, *Depth*, *Figure*, and *irection* ; the *Severn-Sea*, which brings it ither, adjoins to the Ocean, and opens *di-ctly* towards it, to receive it in full Force, d give it no *deflecting* Check at its Enance ; inſomuch that the Tide ſometimes acheth *ſixty Foot* ; and upon the ſpecial Enuragement of a ſtrong *South-weſt* Wind, it erwhelms the adjacent Country in a *De-ge*, beyond Meaſure.

Yet, to exalt the Tidal Flood to its *higheſt* itch, after it is contracted to the Half, by r *Engliſh Channel*, before it reacheth the *Cape* St. *Malo's* in *Normandy* ; it is again ſtraitned the Half, e'er it reacheth the Bottom of *Michael's Hill* ; and there, being pent up a *Corner*, and put to a peremptory Stop, ithout any *Inlet* of a *River*, to take off part the Tumour, it ſwells to *twenty Foot* ; the *gheſt* Tide perhaps, that can be found thro'-t the Univerſe.

Moreover, when *Two* Tides chance to eet, and are united in *One*, the joint Flood comes exceedingly advanced ; the Speed of eir Occurrence one towards the other, being accelerated in a double Proportion to th ſingle Motion of each apart ; as is obſerv'd i the Congreſs of the *North* and *South Tid* both in our *Iriſh Gulph*, at the *Peel* in *Lanc* *ſhire* ; and at the *Mouth* of *Humber*, in t *German Ocean* ; where they amount to *ten F* *thoms*, or *fifty-four Foot* apiece ; tho' it happ at their utmoſt Diſtance from the *Atlanti* and after the Flux of their Currents be alm ſpent into Calm-water ; yet without the *Aſ* *ſiſtance* of the aforeſaid Advantages.

In fine, ſuch is the *gradual* Encreaſe of th Tidal Tumour, as well in the wide *Ocean*, a in our narrow *Seas*, that one New-Moon Flood, runs thro' all the Diverſity I have hitherto deſcribed, within the Space of *twelv* *Hours* ; in paſſing (for Example) from th *Equator* to St. *Malo's* ; inſomuch that *ſix* Fo of Water in the one Place, is advanced to bove *ſixty* Foot in the other : And where it has been obſerv'd, that the *Equinoctial* Tid do not ſuperadd to the reſt, above *ſix Inches* the *Line* ; yet at St. *Malo*'s they ſurmou their Fellows at leaſt *five Foot* ; the Produ agrees exactly with the *former* Account, *vi* that, as a Tide of *ſix* Foot there, produc another here of *ſixty* Foot, in a *Decuple* Pr portion ; ſo does the *ſix* Inches ſuperadd make *ſixty* Inches, or *five Foot*, which is t Number propos'd.

Thus the Tides are diverſified in our *Riv* and *narrow Seas*, with an endleſs *Variety*, bo of Courſe and Growth ſucceſſively, accordi to a regular Order, both of *Time* and *Pla* with a conſtant Dependence on the Flux a

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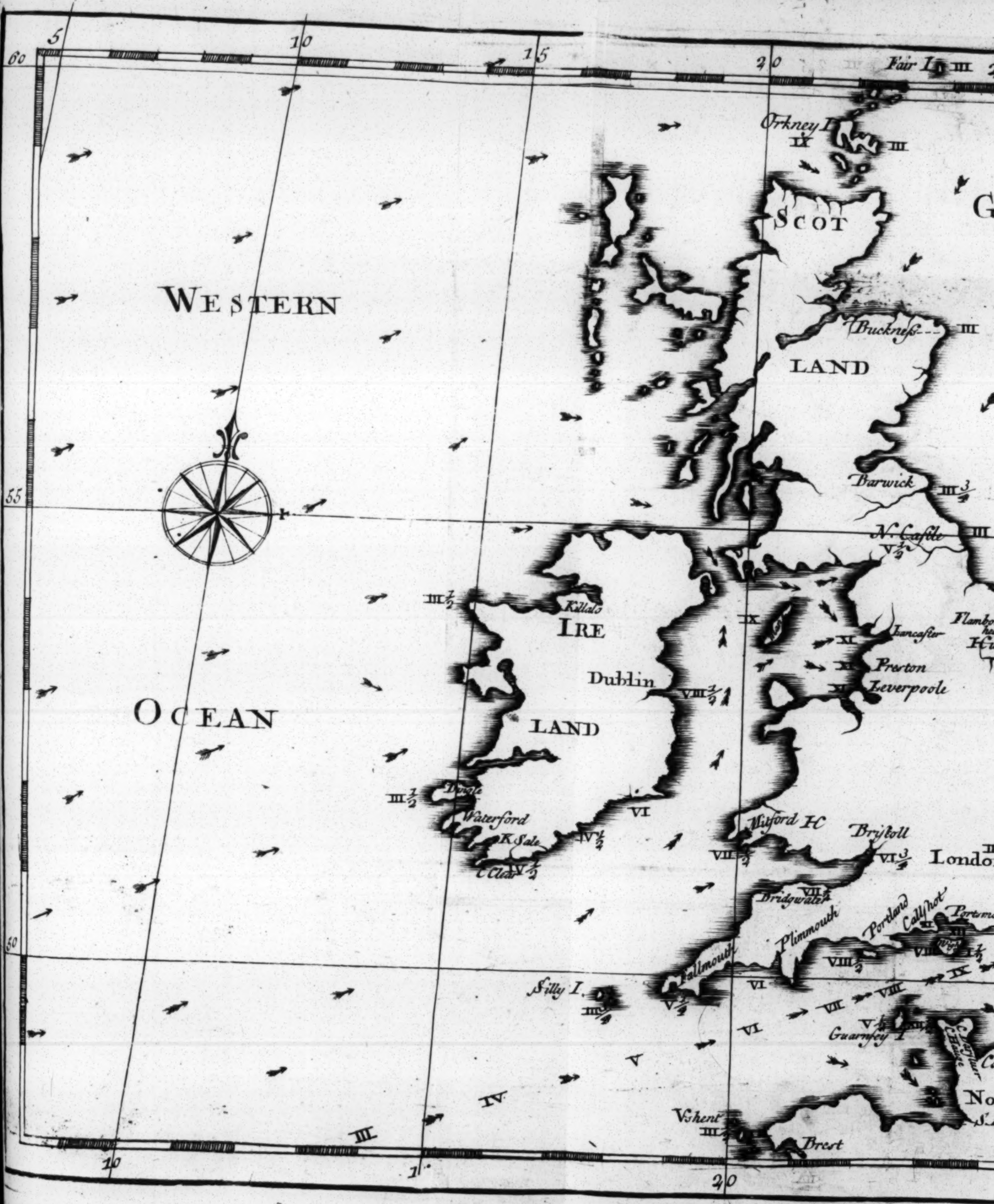
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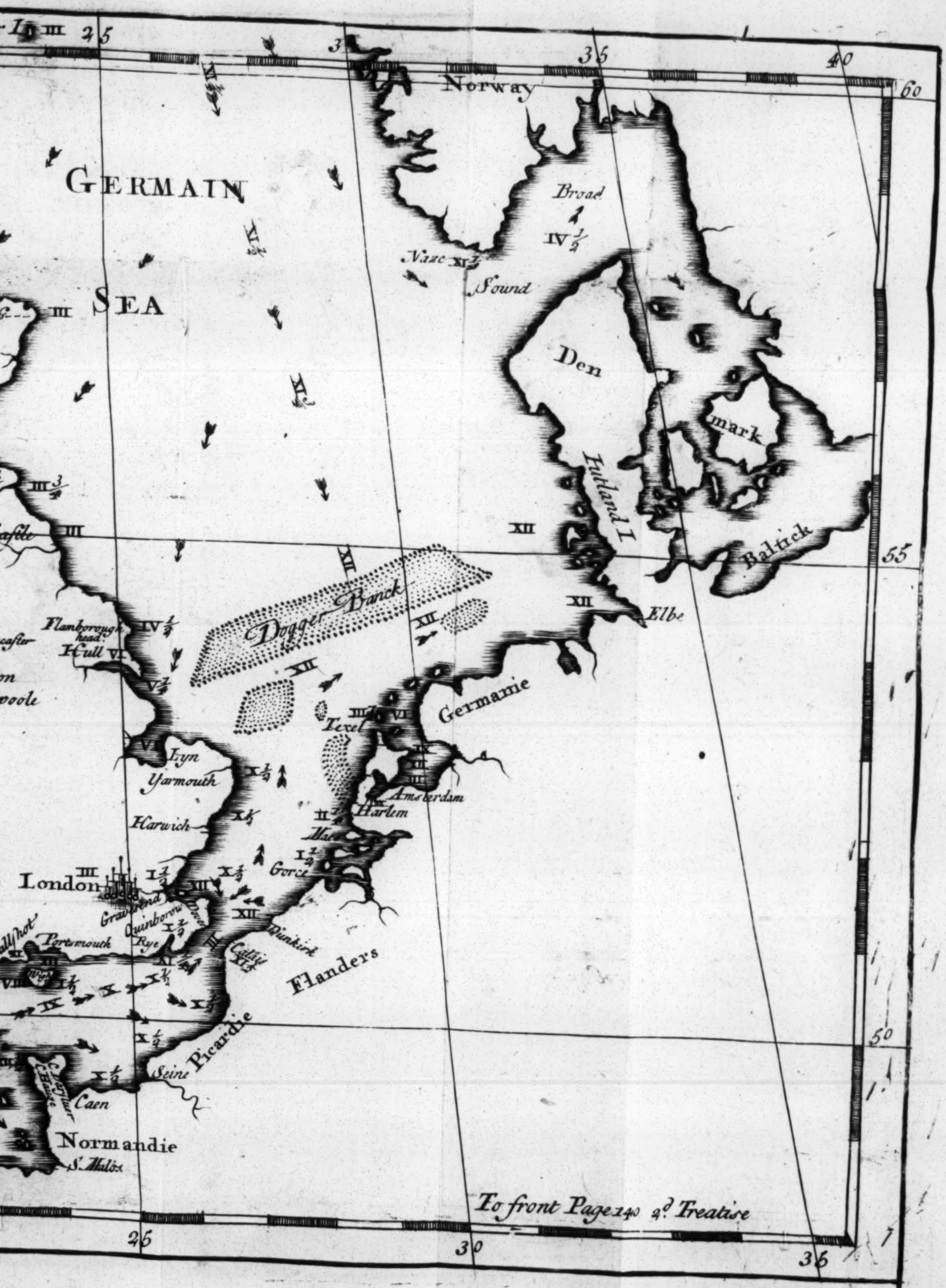

To front Page 140 2d. Treatise

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Reflux of the *Ocean* ; and as received by our *Roads*, and *Ports*, with open Arms : But now it is to be treated, as being *ſhut* up in ſuch *Lakes*, and *Seas*, as admit of *more* or *fewer* Tides than ordinary, and ſometimes without any Communication with it whatſoever.

CHAP. V.

Of the great Diverſity of Tides, in our Inland Seas, *or* Lakes ; *and*, How *they are occaſion'd.*

I Have hitherto conſider'd the *Courſe* of the Tides, and its various *Appearances*, as taking their firſt *Riſe*, from the Moon's Preſſure upon the Sea, near the *Equator* ; inſmuch as they affect thoſe *Ports* and *Arms* of he *Sea*, which have a *free* Communication with the *Ocean* ; and moſtly ebb and flow together with it, *twice in twenty-four Hours :* But, I am now to confine my Diſcourſe to ſuch Bodies of Water, as are *Seas* only by denomination, but *Lakes* in reality, for their little or no *Commerce* with it ; and with regard to thoſe Tides alſo, which immediately proceed om her Preſſure and Preſence, without any Dependence on the *Ocean* at all.

Now, foraſmuch as thoſe *Lakes* which lie wholly *ſequeſter'd* from the Sea, are *differently* ffected by the Tide, from thoſe which enoy a *free* Communication with it : And aain, *Thoſe* become as *diverſly agitated* by its Ti-

Tidal Commotion, each according to thei
reſpective Correſpondence with it ; and *mo*
or *leſs*, with regard to the *Number* and *Cap*
city of the Paſſages which joyn 'em togethe
Hence, for Diſtinction and Clarity's ſake,
begin with thoſe, whoſe Conſideration
moſt *ſimple*, and *ſeparate* from the Sea ; an
proceed to the Reſt, according to the Order o
their *Compoſition*, which have *One*, or *Two* Inle
from the *Ocean* ; and ſhew how they are a
fected thereby ; and each in a diſtinct *Sectio*

SECT. I.

Concerning ſuch Seas, *or* Lakes, *as are wholly ſ* parated *from the* Ocean ; *yet ſometimes E* *and Flow, by the Moon's immediate Preſſure.*

FIRST, the *Caſpian Sea* is not obnoxio
to *any* Tidal Commotion, as lying e
tended from *North* to *South*, athwart t
Moon's *Diurnal Courſe*, which is from *Eaſt*
Weſt ; ſo that her Preſſure muſt affect its S
perficies, much *alike in all* Places at onc
and cannot raiſe the Tide *more* in one Pla
than in another : Beſides, being ſo *ſhallow* t
wards the *Weſt* Side as ſcarce to be *Navigab*
it is not capable to receive a *Counterpoiſe*
Water, to fetch up the *Eaſtern* Part, which
much *deeper* ; that the *whole Lake* may *libr*
reciprocally both ways ; the one End of t
Scales, quite *overweighing* the other.

Next, tho' the *Euxine Sea* be of an eq
Extent with the *Caſpian*, and of a much m
co

mmodious Situation, being ſtretch'd out om *Eaſt* to *Weſt*, that her Preſſure may *roll* er it ſucceſſively; yet it ſuffers ſo *ſmall* a ommotion from it, either to ſet its *Libra-* *n* on foot, or to *advance* it gradually, as rce to render it perceptible; for want of *lining Shores*, to contract it into a narrower ompaſs towards the *Eaſt* and *Weſt Ends*, and rpen it both ways into a Point, as it does the *following Inſtances.*

For, whereas the *Huron-Lake* in *North-Ame-* *a* is of the like Situation, and almoſt of an ual Extent, with the aforeſaid; by being ntracted towards the *Eaſt End*, into a more *te Angle*; it advanceth a Tide to ſo conſi- rable a Height, that *twice* a Day (by the p of its *Libration*) it ſwells the *Canada* more n ordinary, for *five* or *ſix Leagues* toge- r.

Moreover, the *French* report of the *Upper* *ke*, which lies on the *N. Weſt* of this, and s into the ſame River; that notwith- nding it is ſituated *five hundred Fathoms a-* *e* the Superficies of the Sea, and lies at *hundred and ſeventy Leagues* diſtance from it; it Floods to *two, three*, and *four Foot* in ight; which plainly ſhews, that theſe Tu- urs proceed abſolutely from the *Moon's* *ſure*, without the Intermediation of the *an* to raiſe 'em by way of *Libration*, at ſo at a Diſtance from the Sea, and exalted ſo ny *Fathoms* above it.

And whereas my *Author* adds, that the *Up-* *Lake* is a *hundred* Leagues in *Breadth*, and btleſs of a *Length* proportionate; and ſig- ly *Remarks*, that its Tides advance to the

Heights aforeſaid at the *Full-Moon,* with
taking any Notice of the *New-Moon* Ti
at all ; he plainly implies, that either th
happens *no* Tide of the later Sort ; or t
they be of a Size or Number much *inferiou*
the former: And *this Reaſon* is aſſignable
the Diſparity ; *viz.* That, altho' the
join'd Pulſes of the Sun and Moon (at
Change) be equivalent to their *ſeparate*
(at her *Full*) in the *Ocean,* where the
ter's *Volubility* is ſuch, that 'tis all one whe
their Pulſes be *once doubly,* or *twice ſingly,*
ply'd, within the Space of *twenty-four H*
Yet in *Lakes,* wherein, for want of a com
tent *Breadth* and *Depth,* the Tidal Tumour
not *roll* to and fro with the ſame *Freed*
their Pulſes ought to be *repeated twelve-ho*
(as at her *Full*) to give *every other* Vibra
a jog, to keep 'em *on foot* ; and not ex
'em to be *doubl'd* at the *twenty-four Hours* E
leſt, by ſo long a Forbearance, they gro
ſluggiſh and unactive, as, by degrees, wh
to ceaſe.

SECT. II.

Of Inland Seas, *which partake of the In* *the* Ocean *by one ſingle* Streight, *or* Paſſ *and how variouſly they are affected thereb* *reference to the Tide.*

AS to thoſe *Seas* which have a *ſingle* I
courſe with the *Ocean* ; the *Baltick*
a conſtant Correſpondence of Flux and R

ith the *Geman Ocean,* without any Tidal Im-
lſe *from it* ; ſending forth a Stream of Wa-
into it in *Winter,* when the freſh Floods
ell it above the Level of that Ocean ; and
ithdrawing it again in *Summer,* when the
orching Heat of the Sun *ſinks its* Superficies
much below it.

Beſides, the *Gulph* lies in too *crooked* and
kward a Poſture, to be wrought upon by
regular a Motion, as that of the Tide; and
ſituated *too far North,* to be influenced by
e Moon's immediate Preſſure ; and withal
o remote to the *Eaſtward,* and thick-ſhel-
'd on the *Weſt* by the *Orcade's Iſlands,* to be
fluenced with a Tide from the *Atlantick* :
t, on the contrary, the *Mediterranean Sea,*
ing ſituated more *advantageouſly* in the a-
efaid reſpects ; as lying more to the *South,*
d in the Tide's *way* ; and being of a *com-*
dious Figure, is as diverſly affected, both by
e Influx of a *Stream* from the Ocean, and
e *Impulſe* of the Tide.

In reference to the *former* Conſideration, it
allows down, by the *Streight of Gibraltar,* a
ſt Quantity of Water, without any com-
tent *Return* ; and the Reaſon is manifeſt ;
being moſt expos'd to be drein'd by the
ching Beams of the Sun, by means of its
re *ſoutherly* Poſition, than of any other
ke in *Europe* : And, on the contrary, being
ſcarcely *recruited* by the Confluence of *freſh*
vers, conſidering the *Largeneſs* of its Ex-
nſion, and *vaſt Tracts* of Land, which it
ters with its Vapours : as from *Spain* it re-
ves only the *Ebro,* which is conſiderable ;
from

from *France* the *Rhoſn* ; and from *Greece* a *Aſia* only the Influx of the *Boſphorus* ; whi alſo has its Reflux at the ſame time ; and fro the Coaſt of *Africk* only the *Nile*, which of any Account ; the reſt of their Strea (which are almoſt *innumerable*) being funded into the *Indian* and *Atlantick* Ocea without any other Gullet than this at *Gib tar* to make Reſtitution.

And, to conſider this *Midland Sea* with gard to the Impreſſion of the Tide ; fir as to its Poſition to the *Weſtward*, it enjoy *free* Communication with the *Ocean*, to ſtirr'd up at every *twelve Hours* End by Tidal Influence of the *Atlantick*, after manner of *other* Arms of the Sea, which directly into the *Eaſt* : And again, as to Extent, it ſtretcheth itſelf *Eaſtward* ab *fifty Degrees*, from the ſaid *Streight* up into *Levant* ; and carries along with it a com tent *Breadth*, to reſent the Moon's *immed* Preſſure with a Tidal Commotion, like *Lakes* aforeſaid ; which, in *accord* with Diurnal Motion, muſt *ſet* into the *Weſt*, in *poſition* to the Former.

Now, in regard this *Midland Sea*, (at *End* whereof the ſaid two Tides are ſo *ferently* rais'd,) conſiſts of *one entire* Body Water ; they muſt, in ſome ſort, *interfare* w each other : And again, the Moon ma High-water at *Rhodes*, which lies near *one End* of that Sea (as appears by the *T Table*) at her *Southing* there ; and finds it gain at her *Southing*, on the Road of *Gibral* which is the *other End* ; having paſs'd *fifty grees*, or a *Quadrant* of her Diurnal Cir

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to the *Weſt*: Hence the ſaid Tides muſt ſo
ep Touch with each other, as to *riſe* and
l by Turns at every *ſix Hours* End, and com-
ſe one *ſingle* Motion; the *whole Body* of
ater *Librating alternately* from the one End to
e other.

To eſtabliſh the *Union* of the ſaid *Two Tides*
One, by *Counter-libration*; the *Streight*, which
s in the Former, being of too *narrow* an Ori-
e, to receive and raiſe a Tumour ſufficient to
ach the *Levant*; eſpecially the Gulph being
ar *ſtopt up* in the Middle by *Sicily*; which ma-
feſtly *divides* it into *Eaſtern* and *Weſtern Bays*;
hich lie not in *one Strait Line*, but disjoin'd
d diſplac'd, each according to the different
rection of the *Shores*: Yet the Gulph is of a
mpetent *Capacity* to contain, as it were,
o Tides ſo *differently* rais'd at both Ends of
t once; which have free Liberty left 'em
their *Conjunction*, and fall at a *correſpendent*
me, each to *advance* the other, according
its proper and natural Courſe, in reference
their joint *Libration*, quite thro'out the *Me-*
erranean; as I have already deſcribed.

Beſides, the Tides on *both Sides* of their *Axe*
e to near an *equal* Height in the *Eaſtern* to
Weſtern Diviſion: Hence it is, that the
de riſes as high at *Venice* as it doth at *Mar-*
lles; as alſo in the *Euripus* as at the Bottom
the *Levant*; in each reaching about *a Foot*:
d more ſignally to expreſs its Dependence
the *immediate* Preſſure of the Moon, it
re abounds at the *Full* than at the *Change*;
cording to the Cuſtom of *other Lakes*, which
ld an immediate Correſpondence with her
eſence: After all, it ſwells higheſt where

it is *broadeſt* ; and higher on the *North-Side*
the Gulph whither it is driven, than on t
South-Side, where it is taken off by a *Coaſti*
Current (according to the Courſe of the
cean) into the *South-Eaſt Levant* ; whence
came.

Now, to take the Liberty of *Speculation* u
on the Tide in the *Red-Sea* ; (having hithe
had a conſtant Recourſe to *Senſe* and Exp
rience, for *Matter of Fact* in other Places) a
to argue from *Parity* of Reaſon ; altho'
conſiſts of a *long* and *narrow* Body of Wat
continued by a *Streight* to the *Eaſt-Indian*
cean (much like the *Mediterranean* by that
Gibraltar) which is almoſt choak'd up by
Iſland, which *obſtructs* its free Communicati
with that *Sea* ; yet it has a competent T
by the Aſſiſtance of the Moon's *immediate* P
ſure ; lying ſtretch'd out, for near *twenty* D
grees, from *South-Eaſt* to *North-Weſt* ; in
moſt advantageous Poſture for the Moon
affect it at the *South-Eaſt End* firſt, at her *Riſi*
and thence to puſh the Tide forward gradu
ly towards the *North* and *Weſt*, upon her A
vance to the *Meridian* ; and as opportun
to let it fall back again *Eaſtwardly*, at her D
clination into the *Weſt*.

SECT.

SECT. III.

thoſe Gulphs *or* Lakes, *which, by receiving*
their Tides thro' ſeveral *Channels, either* add
or ſubſtract *from their accuſtomary* Number, *in*
ther Seas.

INCE amongſt all the Diverſity of Tides,
which I have yet diſcours'd of, either in
Ocean itſelf, or our *narrow Seas*, High-
ater does regularly affect the ſame Place,
in twelve Hours: It now falls of courſe to
quire, How it come to paſs, that one and
ſame Tide ſometimes flows *oftner*, and ſe-
al diſtinct Tides *ſeldomer* than *twice* in *twen-*
four Hours: And to produce *Inſtances* re-
ctively for that purpoſe,

Firſt, It is obſervable, that *irregular* preter-
nerary Tides (whether by *Exceſs* or *De-*
) affect only ſuch *Gulphs* or *Lakes*, as are
ated *between* two Seas; and thoſe of the
mer Sort, which *exceed* in Number, are
aſion'd by the *Diviſion* of one and the
e Tide into *ſeveral* Streams, by *different*
nnels, conveying 'em thither at *diverſe*
mes; where, notwithſtanding their Divi-
, if they chance to arrive both *at once*,
y compoſe but *one regular* Tide, at their
ction; as plainly appears in our *Iriſh Gulph*,
ere our *North* and *South Channels* meet, and
inarily *re-unite* their divided Floods into
; and alike communicate it to all the
ttuent *Rivers* around the Shore.

But, in caſe the ſaid divided Floods reac not the *Bottom* of the *Iriſh Gulph,* at the *ſam Time;* as is obſerv'd of the *higheſt Equinocti* Tides, when that Part which comes from th *South,* is driven thither *over-haſtily* by a bris *South-weſt* Wind, ſtanding full into the Mout of St. *George's Channel;* before the other Pa can *come up* out of the *North* to join it, (th ſame *South-weſt* Wind ſetting againſt it;) the become *ſupernumerary,* as well in the *Riv Lune,* as in the *Gulph* itſelf; which, the *fo mer* Flood (coming ſooner than ordinary having fill'd with an *unuſual Speed,* retire and the *Later,* finding the Water *fall'n* fi or ſix Feet, *re-advanceth* it as much higher th it was before; making *Two diſtinct* Floods *three Hours* Space, contrary to the Cuſtom the *ſame Winds* and *Tides* in other Places.

Two *New* Tides that hap'ned in the *ſa Gulph,* the Former in *October,* and the Later *March,* 1710, were *remarkable Inſtances* of t Truth; in coming an Hour and Half *ſoo* to the *Lancaſter Sands,* by the *South Chan* than they were expected; and riſing *hig* than was uſual, being *hurried* thither by b ſterous *South-weſterly Winds;* and both *fell,* half an Hour, to near *Half-Tide;* and then again, at the coming up of the *North* Tide, the *other Channel,* five or ſix Feet *higher* than fore; and continued *half an Hour longer* than dinary, before they went off again; the *Nort Tide* having been ſo much retarded, by the *So weſterly Wind* from that adverſe Quarter.

For *Ireland,* lying interpos'd between Ocean and the ſaid *Gulph,* where thoſe T abound; and being ſeparated on the *So*

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Weſt from *Wales*, and on the *North-Eaſt* from *Scotland*, divides every Flood into *Two*, as they paſs thro' their *ſeveral Channels* thither ; where, if they arrive (as they commonly do) at *one* and the *ſame* Time, they are again *re-united* into one *Regular* Tide ; or elſe, if the one be *haſten'd*, and the other *retarded* by the ſame Wind, or by any other Accident, they remain ſtill *divided* into *two Irregular* ones ; till their Return from thence into the *Ocean*, whence they came.

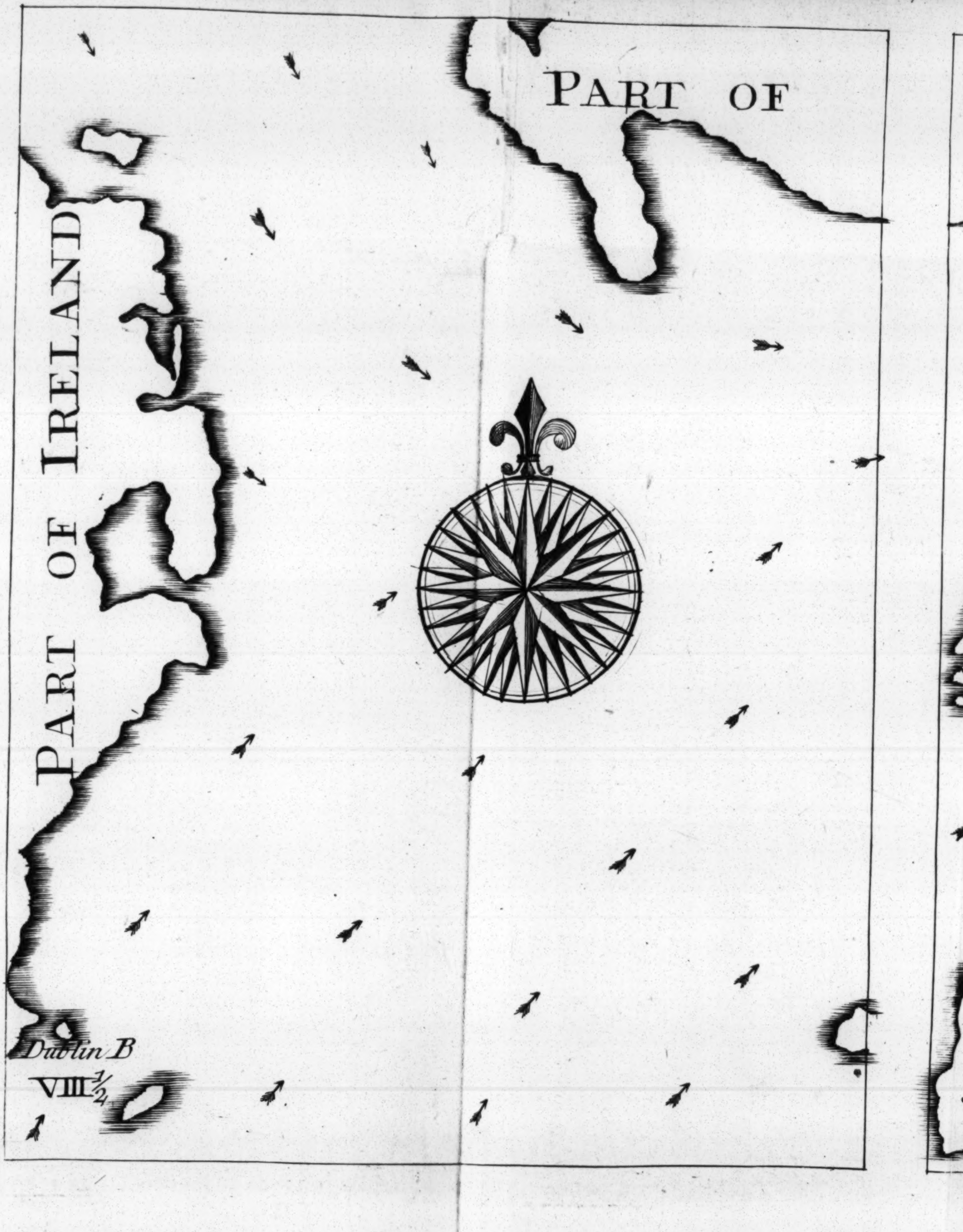
Now, in regard the *Iſle of Walney* is alike *nterpos'd* between the ſaid *Gulph* and the Chanel (or *Race*) which ſeparates it from *Furſs* in *Lancaſhire* ; in caſe the Tide be *Regular*, o, as to ſwell up the *whole Gulph* jointly at nce ; it muſt enter the ſaid *Walney Channel* at oth Ends, at the *ſame* Inſtant; and conſeuently, their divided Streams *meet* in the *iddle* of the *Race*, and re-unite ſtill into *one gular* Flood, as was before : But contrawiſe, if the *North* and *South* Floods remain *vided* in the *Gulph* itſelf ; they ſubdivide *here* to *Four* in *twelve Hours* ; and if that Tempeſt, hich firſt ſeparates 'em, *continues* ſo long ; ey become again redoubled into *Eight* in *enty-four Hours*, by a repeated Succeſſion.

Becauſe, *Walney* lying at the *Bottom of the lph*, and at an *equal* Diſtance from the *uths* of the ſaid *Channels* ; its *Race* ſtretching elf *ſeven Miles* in Length, and ſituated ditly *North* and *South* ; each Tide muſt rectively enter it ſooner at the *one End*, than the *other* ; ſo, as to make *each* its Fluxes init, *apart* ; that every *irregular* Tide, wher from the *North* or *South*, may make

Two of each Sort in this *Gullet*, for One in th *Gulph* itſelf: So that, when *One* Tide of th *Ocean* becomes *Two* in the ſaid *Gulph*; thoſe Two muſt be redoubled, in the *Walney Rac* into *Four* within the Space of *twelve* Hours; and theſe into *Eight* in *twenty-four* Hours, the ſame Means being *repeated*; as is manifeſt.

Hence plainly appears, how Tides may be *multiply'd* above their uſual Number, in *ſom* Seas: Now, to ſhew how they *fall ſhort* of their common Account in others; it was farther obſerv'd, that, altho' the ſaid *Gulph* ſent *Two* diſtinct Floods up *Lune*, as far as *Lancaſter*, for *One* receiv'd from the Ocean by *differen* *Channels*; yet at the ſame Time, thoſe Tw Floods *re-united* into One, in *Marſey* at *Leverpool*; notwithſtanding *both Rivers* had an immediate Communication with the *Gulph* itſelf, becauſe they *comply'd not* alike with its Tid Agitation: For, the *Former* having a *wide* Aperture, and but a *narrow* Channel, wa quickly *fill'd* by the *South* Tide, and ſoo *emptied* together with the *Gulph*: Whereas th *Later*, having contrariwiſe a *large Pool* to b fill'd, and but a *ſtrait Gullet* to let it off agai cou'd not diſpatch its Work, before the *Nor* *Flood* came up, to re-join 'em both into *ſingle* Tide; which ſtood to its *full Heig* with ſcarce any ſenſible Diminution, for ne *two Hours* together.

Thus *one regular* Tide of the *Ocean*, by p ſing thro' *ſeveral Channels*, with *unequal* Spe into the *Iriſh Gulph*, became *Two irregular* on Again, *each* of thoſe Two, by *entring Wa*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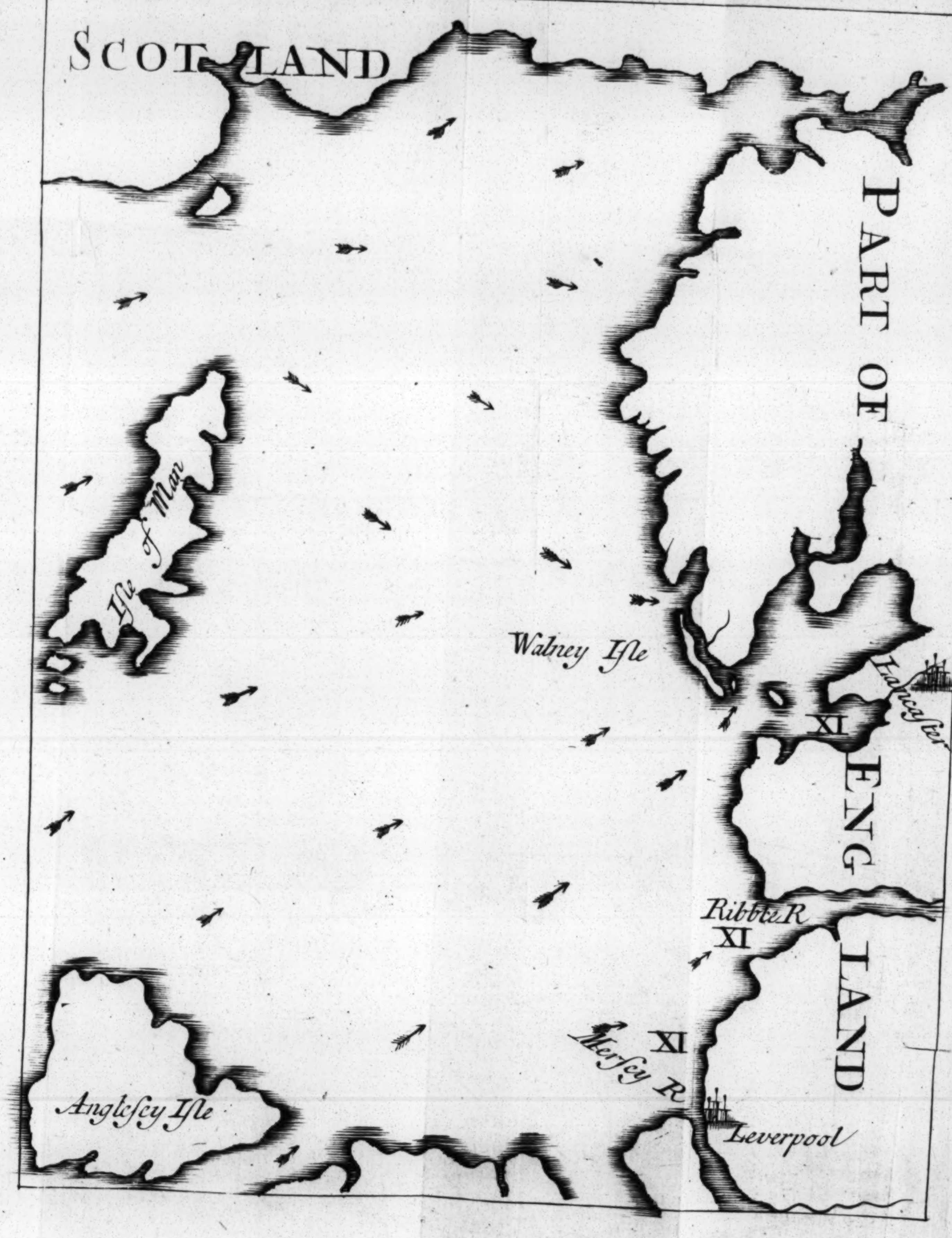

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Race differently, were re-doubled into *Four*; while contrariwiſe, by *haſting too quickly*, the one after the other, into the Port at *Leverpool*, they *re-united again* into one, in *twelve Hours* Space; and by the *ſame Means* repeated, they wou'd have *re-doubled* in *twenty-four* Hours, their Number Four into *Eight*, at *Walney*; and One into *Two* at *Leverpool*: And moreover, had the *R. Marſey* been capable to *contain*, and reduce theſe *Two* laſt into *One*, at *twelve Miles Diſtance* up the River; there had been but *One* Tide at *Warrington*, in *twenty-four* Hours, for *Eight* at *Walney*; as is manifeſt.

Now, this being the preſent Condition of the Tide in reference to the *Euripus*, where it flows *Eight* times, for *Once* in the *Port* at *Tunkin*: I am to ſhew how it is *multiply'd* in the *Former*, by the Interpoſition of *one Iſland behind another*; and in the *Later*, how it is reduc'd to *a few*, by the Poſition of *Ports*, lying in the like *conſequent Order*; and declare expreſly the *Manner*, how *both* are effected in the Three enſuing *Sections*.

SECT. IV.

Of the ſupernumerary *Tides, in the* Euripus; *and their* Analogy *with thoſe which ſometimes happen in our* Iriſh Sea.

IN that *Gulph* which lies between *England* and *Ireland*, which hath *North-Wales* on the South, and on the North *Galloway* in *Scotland*;

it is *obſerv'd*, that, as *One* Tide in the *Ocean*, being divided into ſeveral Streams *ſucceſſively convey'd* thither, makes *Two* Floods; and theſe, being *ſubdivided* by the Interpoſition of *Walney Iſland*, ſeem to become *Four* Floods in *twelve Hours*, and *Eight* in *twenty-four Hours*, within the *Streight* between it and *Furneſs* in *Lancaſhire*: So *One* Tidal Tumour in the *Mediterranean Sea*, in the *ſame Spaces* of Time, raiſeth *Two* in the *Archipelago*; and *Two* here advance *Four* in the *Euripus*, by the Interpoſition of *Candia* and the *Negroponte*: Of which, that I may deliver the *Particulars* after a more ſpecial Manner, in the following *Sections*; let us firſt take a View of its common

DESCRIPTION, *Viz.*

" The EURIPUS is an Arm of the Sea,
" between *Achaia* and the *Negroponte*; ſo *nar-*
" *row* about the Middle of it, that it is paſs'd
" over by a *Bridge*: where the Streight is
" *broader*, the Tides are more *regular* and con-
" ſtant; for, in the *narroweſt* Part, they are
" regular *three* Days before the *Change*, and
" *eight* Days after; and *one* Day before the
" *Full*, and *ſix* Days after, and *the reſt* irregu-
" lar; During which Time, the *Euripus* Ebbs
" and Flows 11, 12, 13, or 14 times in
" *twenty-four* Hours; but during their *regular*
" Motion, they flow as *other* Seas.

" There are alſo *particular Differences*, be-
" tween the Tides of the *Euripus*, and thoſe
" of the *Ocean*: *Firſt*, The Water never riſes
" above *a Foot* high, and that very *rarely* too;
" whereas in many Parts of the *Ocean*, it

“ riſes *twenty-four Cubits: Secondly*, That, in
“ the *Ocean* the Water *falls*, when it ebbs into
“ the *Sea*; and *riſes*, when it rowls towards
“ the *Shore*: Whereas the *Euripus riſes*, when
“ the Water ebbs towards the *Iſlands* of the
“ *Archipelago*, where the Sea is broadeſt; and
“ *riſes* when the Water ebbs towards *Theſſaly*
“ into the *Channel* of *Salonichi*; altho' it is ob-
“ ſerv'd, that at High-water the Water *ſtands*
“ *ſtill*, without moving one way or other for
“ *an Hour*, or *half an Hour* together: But the
reaſon of this, no Man (*ſays the Author*) can
unriddle.

Now, to draw a Parallel betwen the Situation of the *Gulph* which divides *Ireland* from *England*, as the *Archipelago* does *Candia* from *Greece*, on the one Part; and of the *Channel* which ſeparates *Walney* from *Furneſs*, as the *Euripus* does the *Negroponte* from *Achaia*, on the other; in reference to the Tides produced in *all Four* Places: Since they lie all *open* at *both Ends*, to receive their *oppoſite* Floods, either *ſucceſſively*, or both *at once*: As often as they *mutually occur* in the Middle of their Channels, they *unite* each Two into One, at their *Congreſs* in the *Archipelago*; and *re-unite* again in the *Euripus*; as I have ſhewn they do in the *Iriſh Gulph*, and *Walney Race*; and have one *ſingle* Tide apiece, in *twelve Hours* Space, as regularly as in the *Ocean* itſelf and *Mediterranean Sea*, whereon they depend.

On the contrary, at the Seaſons of their *Irregularity*, when the ſaid counterpoſing Floods *arrive ſucceſſively*, one after the other; ſo as to make *diſtinct* Tides, at the *Place* Firſt de-

deſign'd for their *Occourſe* ; their *ſeveral* Streams muſt be *ſubdivided* at the Second; Hence, as every *ſingle* Tide of the *Ocean*, divided by the Interpoſition of *Ireland* into *Tw* *diſtinct* Tides in the ſaid *Gulph*, becomes ſubdivided by *Walney Race* into *Four* : So every Tidal Tumour of the *Mediterranean Sea*, being firſt *divided by Candia*, becomes *Two* in the *Archipelago* ; ſo afterwards *ſubdivided* by the *Negroponte*, it is made *Four* in the *Euripus*, within the Space of *twelve Hours* ; and in *twenty-four* Hours, they double that Number.

Again, whereas the *Ocean*'s Tide requir'd *S. Weſt* Wind, to carry the one Part of i down into the *Gulph*, before the other cou'd arrive from the *N. Weſt*, to keep their Flood *diſtinct* ; and each of theſe were *differently directed* into their reſpective *Ends* of *Walney Race* to tranſmit their Floods into 'em at *ſevera* times : In lieu thereof, it is obſervable, tha the *Mediterranean* Tumour, in paſſing from the *Streight of Gibraltar* to the *Levant*, deflec that Part of it into the *Channel* which ſeve *Candia* from *Morea*, at a competent Diſtanc of Time and Place, from the *other* whic parts it from *Rhodes*; for their Two Stream to produce, *each a diſtinct* Tumour in th *Archipelago*: And theſe, taking as *differe* Courſes towards the *Euripian Streight*, the o being ſo much *ſhorter* and more *direct* than th other, that their *different* Allowances of Tim is *doubl'd* before they reach it; to *ſubdivi* their Tumours here, and *ſubdiſtinguiſh* 'e each apart, no leſs than thoſe did before i the *Archipelago*, without *interfaring* in any r ſpect with one another.

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And if thoſe *North* and *South* Streams, which
w from the *Ocean* into the *Iriſh Gulph*, ſeem
come thither as it were *by Pairs*; and haſte
ſoon the one after the other, to make *di-*
ct Tides after an *Hour and a half*'s Ebb,
her *there*, or in *Walney Race*; the *Mediterra-*
n Flood, to make amends as to that Part of
which firſt enters the *Archipelago*, finds a
rter and readier Paſſage at the *Weſt End* of
ndia; while the Remainder traverſeth the
uth Coaſt of the *Iſland*, above *thirty Leagues*
t of its way to the *Eaſtward*, before it de-
ſts into the ſaid Sea; and every Flood here,
ing *ſubdivided* by the *Negroponte*; that Sub-
viſion, which enters the *Euripian Gulph* at
e *South End*, finds as *ſhort* and *direct* a Paſ-
ge, as before; while the other has the *whole*
ngth of the *Negroponte* to paſs, and to repaſs
e *half Way* back again, by a *narrow* and dif-
ult *Gullet*, before it reaches the *Streight*; to
join its *Compart*, which was retired before it
vanced thither; ſo as to have a full Al-
wance of *Time*, to make a freſh Tide at
ery three Hours End.

And, foraſmuch as the Tidal Tumours in
e *Archipelago* are ſcarce *perceptible*; yet their
pending Floods are *diſtinct* enough in the
uripus, as entering *alternately*, at the Di-
nce of the Time aforeſaid: That from the
uth, by a Channel of a *wide* Aperture,
hich *contracts* it gradually almoſt into a Point,
give it *Height* in the *Streight*; while the
her from the *North* makes uſe of the *like*
dvantage, to raiſe its Water *above* the *Archi-*
lago, their common Source: And, on the
ntrary, tho' the Tides run *very high* in the

Iriſh Gulph, as being influenced immediatel by the *Ocean*; yet they are *ſcarce* diſtinguiſha ble in *Walney Race,* becauſe of the *Shortneſs* its Channel, and the *ſudden* Hurry of i Streams thro' it; which, for *Number* of Flux and Refluxes, are the *ſame* with thoſe of th *Euripus,* tho' without the like Tidal-*Diſti ction.*

Eſpecially, in regard the ſaid *Irregulari* proceeds, in the *Iriſh Gulph,* from an *exceſs* Flood *haſten'd* by *Storm*; which never ha pens, but at *Change* and *Full,* and moſt when the Moon is at her *Equinox*: But th *Multiplicity* of the Tides in the *Euripus,* fa conſtantly at her *Wane,* thro' *Defect* of Wate when the *South* Tide cannot hold out Courſe, 'till the *North* Flood comes up to jo it: So that *both fall back irregularly* before th Union; which happens periodically *twice* ev ry *Month,* and for *ſeveral Days* togethe Whereas in our *Weſtern Gulph,* thoſe Sprin Tides are *ſeparated* by Anticipation, and on accidentally, but *twice* or *thrice a Year,* wh the Wind proves *favourable* to the one Sid and *adverſe* to another.

Yet, whether the Tide's *Irregularity* pr ceeds from an *Exceſs* or *Defect* of Water; th *Regularity* ſtill ſuppoſeth a perfect *Re-union* the Tide, to ſucceed in the ſame Place, af every *Separation*: And as often as ſeveral Pl ces *depend* each on other; the *Re-union* in t later Place, ſtill ſuppoſeth an *Union* of t Tides in the former: Hence, the *regular* Tid in the *Euripus,* muſt preſuppoſe the *Union* two *preceding* Tumours, in the *Archipelag* and this to be cauſed at the *Full* and *Chang*

whe

hen both the Sun's and Moon's *Concurrence*, *Southing* upon the *Levant*, falls in with the cean ; and more eſpecially at the *Change*, hen they *South there both* at once, jointly to force their Meridian Preſſure.

And the *better to unite* Two of thoſe Tu- ours into One, when the Preſſure is conſi- rably *encreaſed*, it ſtirs up a *Libration* in the *vant*, from *South to North*, tranſverſe to that hich is *deriv'd* from the Ocean, which is om *Weſt* to *Eaſt* : And this moving alternate- backward and forward, *all at once*, is apt *retard* the firſt Tumour, and *haſten* the later, the ſame *Undulation* ; and theſe ſo united ow *enabled to raiſe* a correſpondent Tide in e *Euripus*, to continue at the ſame Height *an Hour* together: Whereas the *irregular* *divided* Floods, *riſe* and *fall* at the *half Hour's* d, without the *mutual Support* of each o- er.

And, foraſmuch as the Channel to the *ſtward of Candia*, affords a ſhorter and dier Paſſage, and points *more directly* to- rds the *Euripus*, to tranſmit a *ſtronger* and *cker* Flood into the *Archipelago*; the other, hich traverſeth the *Length of that Iſland*, be- e it diverts into it, can only be a *ſlow* and *k* one on that Account : Yet the Moon's *thing* upon the Mouth of the *Eaſtern* Chan- , and enforcing her riſing Preſſure *gradual-* thereon, from the *S. Eaſt Levant* for *one hun- d and fifty Leagues* together, muſt ſuffice to *alize* its Flood with the former, in the *Ar- pelago* ; and conſequently to raiſe *four equal* des in the *Euripus*, in the *firſt twelve Hours* her Preſence, to enforce it.

Yet in the *next twelve Hours*, after her
parture from our *Hemiſphere*, that ſecond
deflected Arm of the *Mediterranean* Tide, be
deprived of her preſent Aſſiſtance, is ther
diſabled for raiſing its Tumour in the *Arch*
lago, to its *former* Height: Again, this
mour being *ſubdivided* by the interpoſing
groponte, before it enters the *Euripus*; he
that Branch of it, which deflecteth agai
the *Northward*, and is to return into the *S*
by the aforeſaid *narrow reflex'd Gullet*,
languiſh away into a *Faint*, and become
perceptible, before it reach the *Streight* it
So that theſe *Three* remaining Tides, b
added to the *other Four*, compleat the Nu
of *Seven*; which are *all* that can poſſibl
incident to the *Euripus*, according to the
gar Account.

So cloſe does the *Parallel* between the
Seas, and their reſpective Tides (all Circ
ſtances duly *conſidered*), hold to concl
that *Two regular* Floods, and *Seven irre*
ones, are incident to the *Euripus*, at thei
veral Seaſons; tho' cauſed originally, by
regular Impulſe of the *Mediterranean Sea*, w
flows but *twice* in *twenty-four* Hours:
the great *Diverſity* of the *Means* WHE
and of the *Manner* HOW, the ſame Wo
differently wrought; is ſo far from leſs
the Validity, or obſcuring the Evidenc
the Effect, on *either* Part; that their *Di*
ties (as *Light* and *Darkneſs* counterpos'd
once mutually *confirm*, and *illuſtrate* each
ther to Perfection: Let us now accord

d *Diverſity* of the *Euripian* Tides amongſt mſelves, with thoſe of *other Seas.*

SECT. V.

ſervations upon the Diverſity *of Tides, in the* Euripus; *and how conſequent it is to my pre-cedent Diſcourſe, of the Tides in* other Seas.

HAVING already ſtated the *Number* of the Tides, in the *Euripus,* according to Evidence of Reaſon, and Experience; it w follows of courſe to enquire into the *ans,* and *Manner* of their Diverſity; with Reſpect to the *Terms,* and *Tenour* of its mer *Deſcription*; to ſhew *how* it ſquares with *Principles,* I have already laid; and the *thod* I have follow'd thro'out my Diſcourſe on the ſame Subject.

irſt, It is obſerv'd, That the Tides are *re-*r about the *Full* and *Change* of the Moon, d become *irregular* at her *Wane*; becauſe at *Change* and *Full,* when they flow in ample nner, the *South*-Tide becomes both *quicker,* d laſteth *longer*; ſo as to hold out Flowing, the *North*-Tide can arrive by the *other* annel, to *join* it; as well in the *Archipela-*as in the Streight of the *Euripus*; in both ich Places, they make but *One regular* Tide, ſequent to the *Mediterranean*; whereas in *Wane,* for want of a *ſufficient Supply* of ter, the *former* Tide retires, before the can come up to join it; ſo as to make *Two*

Two ſeparate Tides, in the *Archipelago*; whic being again *ſubdivided* in the *Euripus*, mu make *Four irregular* Tides; as is manifeſt.

Secondly, Their *Regularity* continues *fo Days* longer at the *Change*, than at the *Full* which muſt needs proceed from a *greater* De preſſion made upon the Sea, by the *joint* C*operation* of the Sun's Light, and Heat, wi *her* Preſſure at their *Conjunction*, than at the *Oppoſition*; when their Forces are *ſeparate* and cannot at once affect the *Mediterranean.*

Thirdly, The *Terms* of their *Regularity* b gin but *two* or *three* Days before the *Chang* and *Full*, when the Moon's Influence is at *Height*; and yet continue for *ſix*, or *eig* Days afterwards; which plainly ſhews, th the *Mediterranean* Tides, are not forced to competent Height, point blank, by the *dir Impulſe* of the Moon; or by the *firſt Puſh* the *Atlantick* Flood, thro' the *Streights*: b are rais'd only *by Degrees*, with the Aſſiſtan of *Reciprocal Librations*; which find the Sea along, from thence to the *Negroponte*, mo *quiet* and compos'd; and ſo they muſt be *ten repeated*, before its Motion be conſiderab heighten'd, at ſo great *a Diſtance*; which gain requires a proportionable Time *after*, *abate again* into its former *Irregularity.*

Fourthly, The Water in the *Euripus*, ne riſes above *a Foot*, and that very *rarely* to whereas in many *Ports* of the *Ocean*, it ri *twenty-four Cubits*; becauſe thoſe *Ports* recei their Tides, with Mouths *wide open*, imm diately from the *Ocean*, their common Sour But, on the contrary, the *Euripus* derives Flood, *in part* from the *Atlantick*, thro' t rrow *Gullet* at *Gibraltar*; and down the *Me-terranean*, for *three hundred Leagues* together: nd *in part* from the Moon's *Impulſe* upon that a, where it wants the *Breadth*, and *Depth* of e *Ocean*, to raiſe its *Undulations*: So that 'tis wonder, if every *Cubit* languiſheth into *lf an Inch*, before it affect the *Negroponte*, at *vaſt* a Diſtance, and Diſadvantage.

Fifthly, In the *Ocean* the Water falls, when ebbs into the *Sea*; and riſes, when it rowls wards the *Shore*; whereas the *Euripus* riſes, hen the Water ebbs, either towards the *Sea Shore*, indifferently; and can do no leſs, ing a *Thorowfare Channel* for *Two oppoſite* ides, to paſs and repaſs thro' the *Streight*; here they never arrive exactly at *the ſame me*; and that which *advanceth* firſt, moſtly *ires*, before the other attain to its *full Height*: that the *one Flows*, while the *other Ebbs*, her towards the *Land*, or *Sea*, reſpective-

Sixthly, It is obſerv'd, that at High-water e Water *ſtands ſtill*, without moving any y for *an Hour*, or *half an Hour*, together; at is to ſay, the Water ſtands ſtill only for *f an Hour*, when the Tides are *irregular*; e Tide ſtill *returning*, before the other be vanc'd to *join* and *ſupport* it: But if they be *ular*, the ſupervening Tide always keep e other up, at leaſt *half an Hour* longer: when the *South* and *North Atlantick* Tides et upon the *Equator*; the *Former*, which ives an Hour and half ſooner, is *kept up* by e *Later*, to its full *Height*, for near *three urs* together.

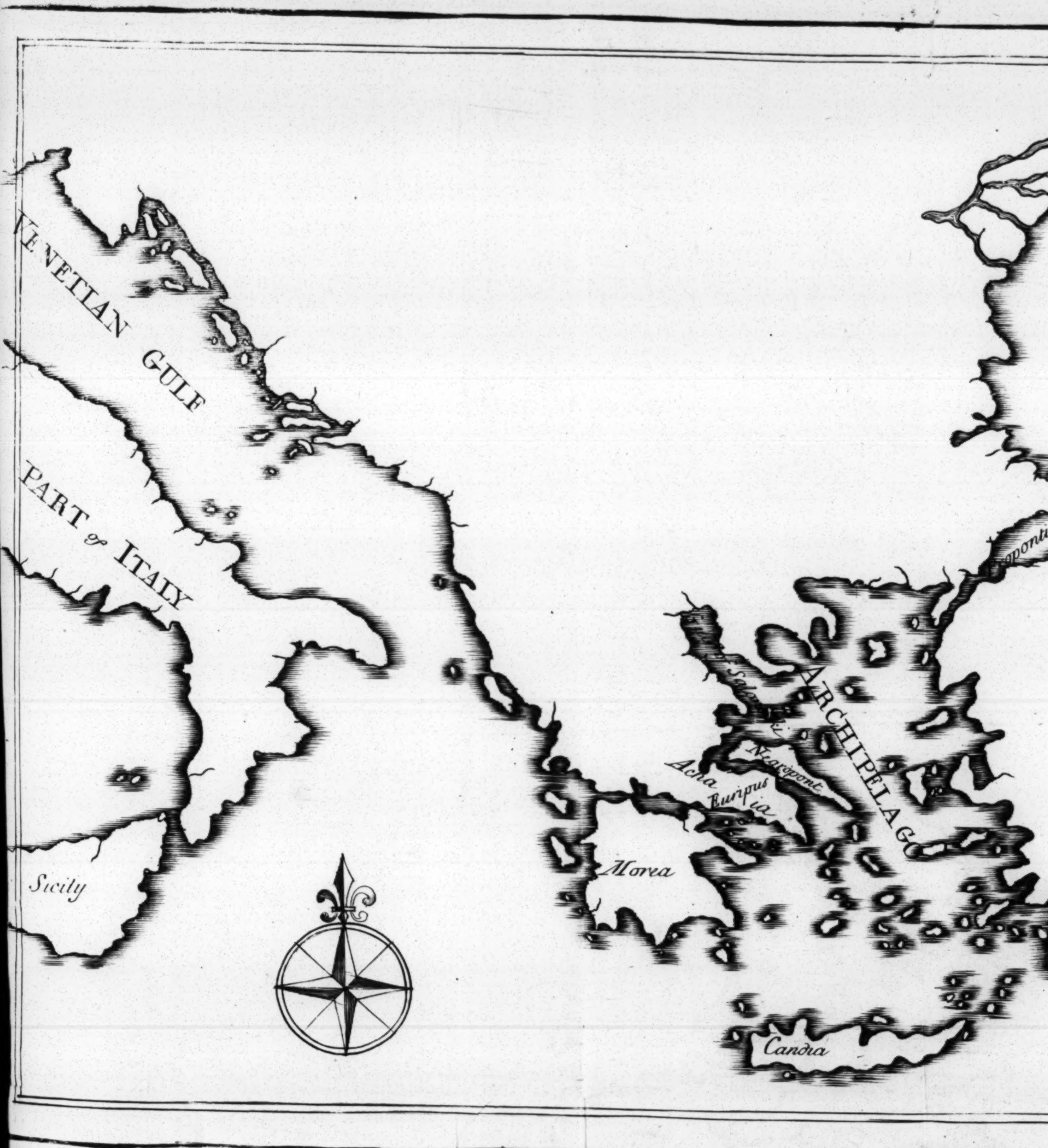
Laſtly, During the Time of their *irregular*
ty, the *Euripus* ebbs and flows 11, 12, 13, o
14 times in *twenty-four* Hours; doubtleſs, a
depending upon the *various Influence* of th
Sun and Moon; according to their *differ*
Aſpects, between their *Conjunction* and *Oppo*
tion; beſides the Change of their *Latitu*
and *Variety of Diſtance* from the Earth; whi
muſt make as various Tides, both for *Numb*
and *Proportion.*

And it is no wonder, that this *Irregular*
ſhou'd rather appear in the *Streight* of the *E*
ripus, than in any *other Sea*, being ſo contriv
by the *Great Architect* of the *Univerſe*; as if o
purpoſe, to hold the *Ballance* of the Two *o*
poſite Gulphs, with ſo equal a Hand, as to
turn the *Scales*, upon every Inch of *Adv*
tage, on either Part, and is placed ſo *comm*
diouſly, on the Backſide of *Achaia*, as to *we*
the various Tumours of the *Archipelago*, up
the leaſt *Commotion*, which way ſoever th
approach it, as they paſs by; while the Ti
after ſo *long* a Courſe, as from the *Streight*
Gibraltar, is in ſo faint and *languiſhing* a Co
dition, (as in *no other Sea*,) to be *ſcarce* p
ceptible.

§.

Remarks *upon the Obſervations aforeſaid.*

To ſum up the *whole Account* I have gi
of the Tides of the *Euripus*, and the *Rea*
for them, in reference to thoſe I have alre
obſerv'd in the *Ocean*, and diſcuſs'd thro
my *precedent Diſcourſe*; in order to *confirm* th


VENETIAN GULF
PART of ITALY
Sicily
of Salo
ci
ARCHIPELAGO
Negropont
Acha
Euripus
ia
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Candia
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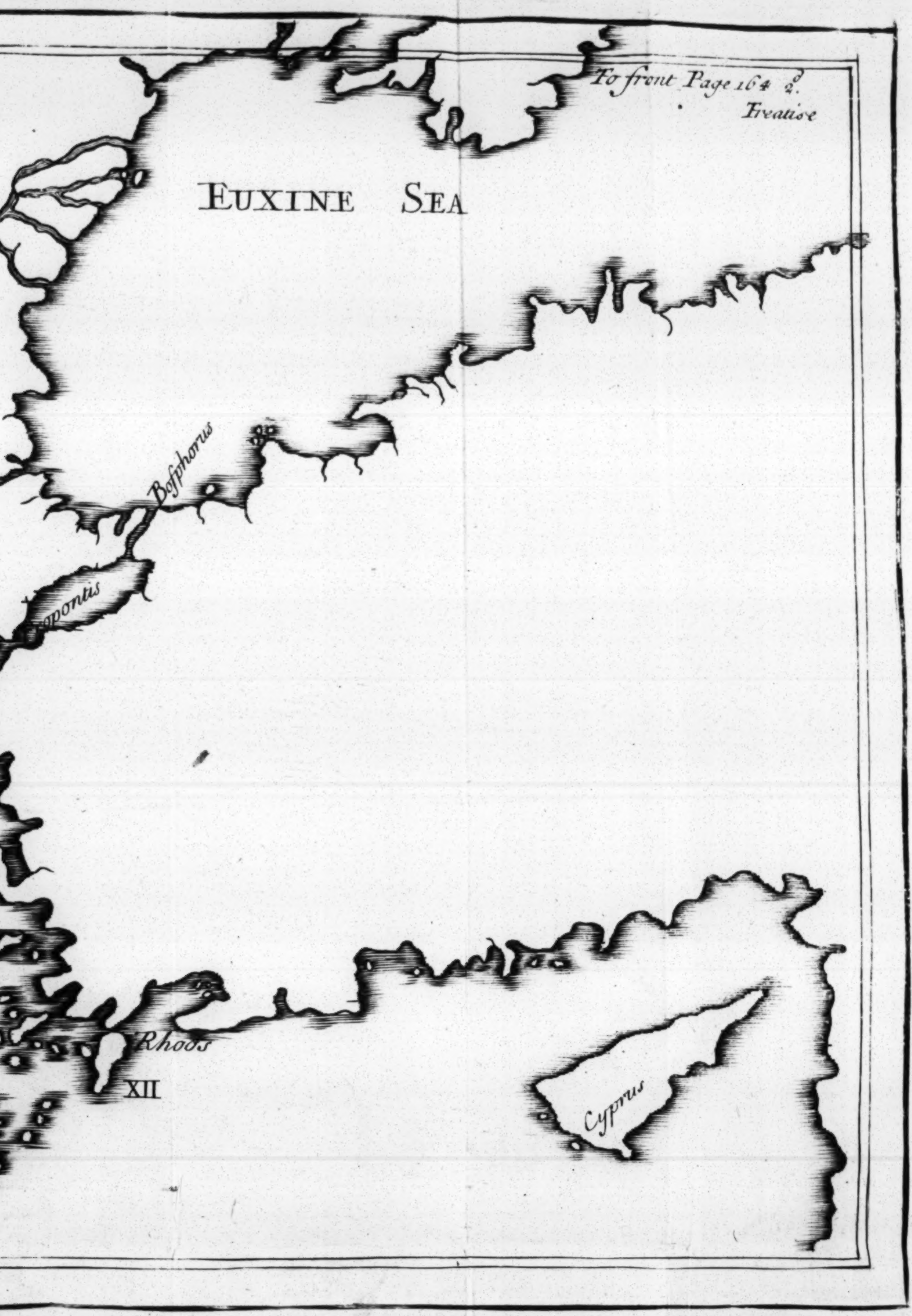

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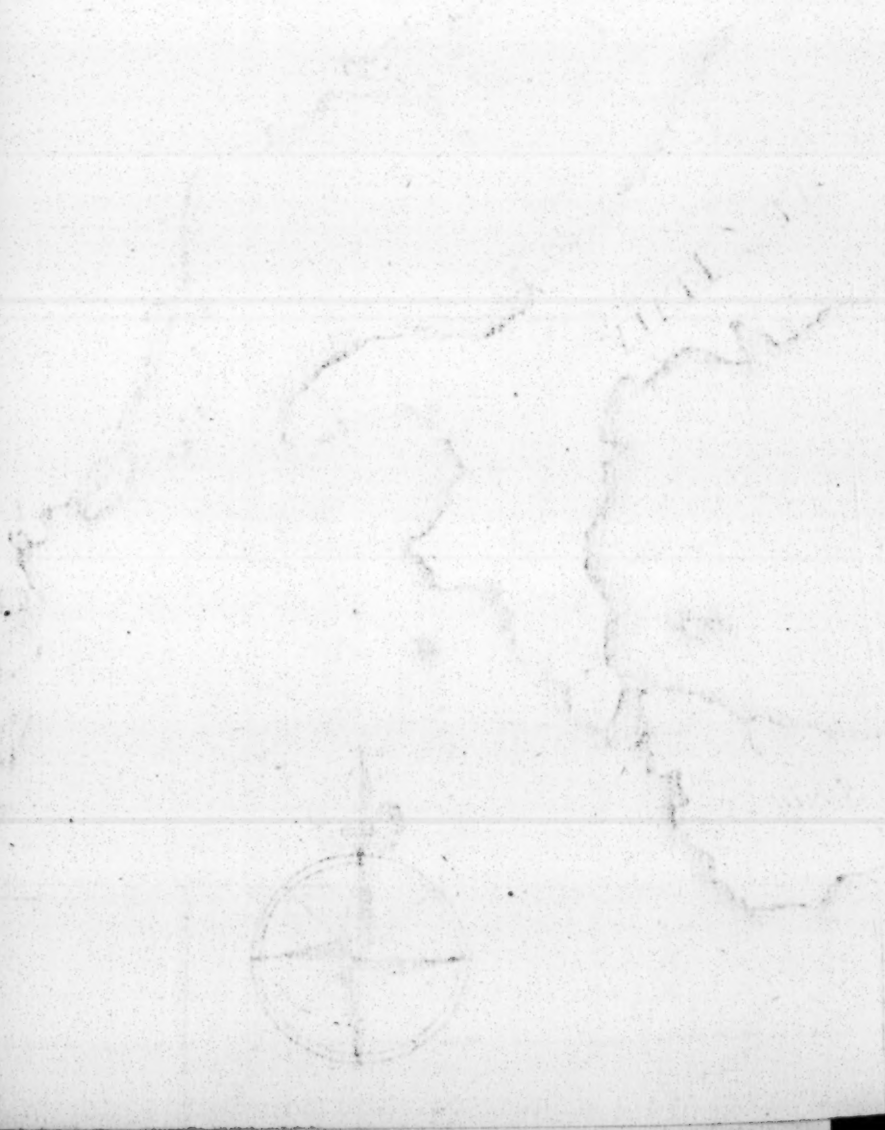


by a Rehearſal of ſome Paſſages here and there, and *comparing* them together.

Firſt, It is to be noted, that the *Mediterranean* Tide, according to its *common* and diurnal Courſe, always produceth *irregular* Tides in the *Euripus* ; as falling ſhort of a *competent Height*, either *there*, or in the *Archipelago* ; as I have all along taken notice.

2*dly*, That, to reach its *regular Height*, its *Menſtrual* Courſe is advanced, by the joint *Concurrence* of the Sun's Influence (as in the *Ocean*) with the Preſſure of the Moon ; both upon the *Equator mediately*, and *immediately* upon the *Levant* ; as hap'ning conſtantly about her *Change* and *Full*, when they concur s aforeſaid : Yet,

3*dly*, Their Influence works *more effectually* t their *Conjunction*, in the *Preſence* of them oth, than at their *Oppoſition* ; when ſhe is *ab*-*nt* from our Hemiſphere ; when the *ſingle* mpulſe of the *Atlantick* muſt do the Work ; ence, there are more *regular* Floods at the *hange*, than at the *Full*.

4*thly*, The *Term* of their *Regularity*, begining but *two* or *three* Days before the *Change*, nd *Full*, when the Preſſure is *greateſt* ; and, ontinuing *ſix*, or *eight* Days after ; plainly emonſtrates, That the Tides are *not raiſ'd* to hat Height, neither *here*, nor in the *Ocean*, y the meer Dint of their Impulſes ; but as *iſted* by repeated *Librations*, which are neiher *ſoon raiſ'd*, nor *ſoon allay'd*.

5*thly*, Notwithſtanding all thoſe *Advan*ges, even the *Regular* Tides never riſe above *Foot* in Height, for want of the *Sea-room* the *Ocean*, to rowl in *Latitude* from Pole to

Pole ; or in *Longitude*, from the *Streigh'*
Mouth, to the *Bottom of the Levant* ; withou
being interrupted by the Interpoſition of *Si*
cily, in the very Middle of its Courſe ; wher
the awkward Devarication of the intervenin
Paſſage, *breaks its Force* to almoſt nothin
before it can reach from one End of the *M*
diterranean to the other.

6thly, Nor were it poſſible, that the Tid
ſhou'd be kept on foot, for *ſix hundred Leagu*
together, by the *ſingle* Impulſe of *ſo narrow*
Gullet, the *one* way ; did not the *Moon's I*
fluence, alternately puſh it again the *other*,
leaſt *once* in every *twenty-four* Hours ; which
conſtantly does, from her *Riſing* till her *Sout*
ing, at the Road of *Gibraltar* : Much le
cou'd it raiſe the Tide higher at *Venice*, b
yond *Sicily*, which *obſtructs* its Courſe ; th
at *Marſeilles*, on this Side *that Iſland* ; did n
the *Moon* influence it as powerfully on t
Eaſt Side, as the *Streights* do on the *Weſ*
and this alſo not by *Attraction*, but by *Pr*
ſure ; ſince the Tide is *driven* all along, up
the *European Coaſt*, and not *drawn* towards t
African ; and is rais'd to the *greateſt Heig*
where the Sea is *broadeſt* ; as between t
Bottom of the *Venetian Gulph*, where the Ti
moſt abounds ; and the *African Shore*, where
is *ſcarce perceiv'd* at all.

Finally, Nor cou'd the *Variety* of Flux, a
Reflux be produc'd, without the *ſpecial* Cont
vance of the Sea's *Situation*, for that purpoſ
As, to *divide One* Mediterranean Flood i
to *Two*, by a *Two-fold* Paſſage into the *Arc*
pelago ; and again to *ſubdivide* theſe *Two* in
Four, by the *ſame* Means in the *Euripus*, whi

th

he Water keeps *low:* And, on the contrary, upon its *Riſing*, to *rejoin* thoſe *Four* into *Two*, nd re-unite thoſe *Two* into *One*, after their eparation.

So little does the *Diverſity* of Tides, found n our *narrow* and *ſhallow Seas*; and much leſs he various Fluxes, and Refluxes of the de- ending *Rivers*, argue any *Irregularity* of Mo- on in the *Ocean* itſelf; or the leaſt *Deviation* om the Intercourſe of the Sun, and Moon, hich I have *already* deſcribed; but meerly oceeds from ſome *Inequality* of the Paſſages d Shores, which *haſtens* or *retards* their Moti- n; or Diſproportion in the *Situation* of the ace, that gives them as *different* a Recep- on.

Nay the *Euripus*, which for its *Multiplicity* d *Variety* of Tides, has been hitherto an xtricable *Riddle*, to *puzzel* and *perplex* all ankind; is ſo far from laying any *new Dif- lty* in our Way; That, when *its Situation*, d the Motions of the Tide *conſequent thereto*, duly conſider'd; it proves to be a very fa- urable and explanatory *Inſtance* and *Exam-* , of what I have diſcours'd upon this Mat- , in other Places.

SECT. VI.

Of the ſmall *Number of Tides in ſome other* Pl
ces; *and* Why, *in the* Port at Tunkin, *the*
happens but one Flood *in twenty-four* Hour
and twice *each Month*, no *Tide at all.*

SINCE the *Plurality* of Tides, above t
uſual Stint (as I have ſhewn) procee
from the like Number of *Channels*, dividi
'em as they *ſucceſſively paſs* into the ſame *Gul*
or *Port:* And, on the contrary, their *Pau*
is occaſion'd by as many *Gulphs*, ſtill *c*
tracting diſtinct Tides, and thoſe alſo deri
from *different* Seas, into *half* their Numbe
And ſince I have made it plain, how the *c*
mon Tides, which conſtantly affect *other S*
but *twice* in twenty-four Hours, beco
doubled in the *Iriſh Gulph*, and *redoubl'd* in
Euripus: It now remains, on the contrary,
produce a *Parallel Inſtance*, wherein *Four*
ſtinct Floods, and thoſe alſo proceeding fr
diverſe Seas, are daily *join'd* into *Two*,
theſe *ſubjoin'd* at laſt into *One*; and this a
is ſometimes *intermitted:* And in order
ſhew, by what *Means* it is effected; take h
what is reported of the *Port at Tunkin* in *Ch*
for Matter of Fact:

" In the ſaid *Port*, there is but *one* Fl
" and Ebb in *twenty-four* Hours; and *t*
" in each Month, (*viz.* when the Moo
" *near the Equinox*) there is *no* Tide at
" but the Water is *ſtagnant*; but with
" Moon's *Declination* there *begins* a T

" wh

“ which is *greater* when ſhe is in the *Tropical*
“ *Signs*; only with this difference, that
“ when the Moon is to the *Norward* of the
“ *Equinoctial*, it flows when ſhe is *above the*
“ *Earth*, and ebbs when ſhe is *under it*; ſo,
“ as to make High-water at Moon's *Setting*,
“ and Low-water at Moon's *Riſing*: But, on
“ the contrary, the Moon's being to the
“ *Southward*, makes High-water at *Riſing*,
“ and Low at *Setting*; it Ebbing all the
“ Time, ſhe is *above the Horizon*; as appears
“ more at large, *Philoſ. Tranſact.* Numb.
“ 162.

To diſcloſe the *Cauſe* of this odd Appearance of the Tide at *Tunkin*, with regard to what happens of the ſame Nature in the *Iriſh Gulph* and the *Euripus*; it is to be *noted*, that theſe *three* Arms of the Sea are ſtretch'd out from *North* to *South*, and lie open at *both Ends*, to receive their reſpective Floods; which here at *Tunkin*, are propagated from *different* Seas; by the *North Channel* from the *Pacifick*, and on the *South* from the *Indian O-ean*: But what is more *remarkable*; at the *Middle* of the *Gulph* (where theſe Floods meet), lies open a *Bay* of a vaſt *Extent*, to receive 'em, and to carry their Streams to the *Port*; where they make but *one* Flood and Ebb in *twenty four Hours*; and the Manner how this is effected, is what I now undertake to deſcribe.

As for the *Manner* of their Concurrence, inſtead of hitting an exact Time for their Conjunction, the *South* Tides arrive not 'till *ſix Hours after* thoſe out of the *North*; the *Indian*

Ocean, whence they are propagated, lying a leaſt *ſeventy Degrees* to the *Weſtward* of the *Pacifick*: Beſides, the *Molucca's*, which they ar to *traverſe*, muſt be no ſmall Impediment, t *retard* their Journey thither: So that thei Floods muſt reach the *Gulph ſucceſſively*, on after another, at *ſix Hours* Diſtance: Yet, i regard *each Two* of the ſame Sort, have thei reſpective *North* and *South-Paſſages*, for thei Entrance into it; and come no oftner tha *Twice*, within the Space of *twenty-four Hours* they have *twelve Hours* apiece, to make thei Fluxes and Refluxes, forward and backward as compleat as in *other Seas*.

But all *Four* Floods, when they reach th *Middle* of the *Gulph*, being of courſe *to ente* into the Mouth of the *Bay*, ſucceſſively a *every ſix Hours* End; and it being a Lake o *a vaſt Extent*, and *horizontally Level*; their recurring Ebbs cannot make *ſo quick a Return* out of it, as not to ſtagnate: Beſides, on Flood ſtill *overtaking* another, e'er it be *ha* ſpent, the Water in the *Bay* muſt *riſe all th while*, and ſwell up a Tumour in the *Port* which lies in the *Bottom* of it, 'till it reach *determinate Height*, which cannot be ſurpaſs'd and muſt ſtand *mounted* to that advanced Pitch as long as their united Forces continue *equa* to ſupport it *alike* all the while; as it happens when the Moon is *near the Equinox*.

But the State of this Topping Flood bein *violent*, ſo as to raiſe the Water in the *Port* above the *Bay*, and in the *Bay* above the *Gulph* and in the *Gulph* above the *natural Level of th Oceans*, whence they proceed; and is raiſe by ſome *Two* of thoſe Floods, which chanc

t

to *over-power* their Fellows; this ſurpaſſing Height of Water, muſt ebb off again on the *weaker Side*, in as *long a Time* as it was in riſing; that is to ſay, in *twelve Hours* apiece: So that *all four* concur to make but *one Flood and Ebb in twenty-four Hours*; as is manifeſt.

Now, to aſſign which two Tides muſt be *predominant* over the other, with regard to the *Situation* of the ſaid Port: Since it lies *eighteen Degrees* to the *North* of the *Equator*; the *North* Tide, muſt needs be Superior: *Again*, forasmuch as the Primary Tides muſt *exceed* the Secondary Ones, the *Primary North*-Tide muſt be *Supream*: And, ſeeing the *Port* lies between the *Tropicks*, the ſaid *North*-Tide muſt make *High-water* at the *Moon's Setting* (as it actually *happens at Tunkin*), as being the *Reſult* of the Ebb which ſhe had cauſed by her Preſſure, at her *Southing* upon the ſame Meridian.

Again, the *Secondary North-Tide* muſt needs exceed any that can be rais'd in the *South*; in regard the *Pacifick Ocean*, whence it is propagated, coaſts the *Gulph* all along upon its *North*, and *Eaſt* Quarters; where it finds Store of *Inlets* to receive it, which are both ſhort and direct: Whereas thoſe from the *Indian Sea* come farther off; and, having the *crooked* Windings of the *Molucca Streights* to traverſe, are half *ſpent* before they arrive: Beſides, this *Secondary* Tide, hap'ning *twelve Hours* after its *Primary* One, falls at a right Time to work the *ſame* Effect in the *Port*, by the Concurrence of its Aſſociate out of the

South, at the *Riſing* of the Moon, that its Competitor did at *Setting*.

Now, to ſtate the reſpective *Efficacy* of their *mutual Concurrences*, as they make one circular Revolution, according to their *ſix hourly Succeſſion*, as I have already deſcribed; it is *remarkable*, that, whereas the *Primary North-Tide* has but the *Secondary* One out of the *South* (which is the laſt and *weakeſt* of that Order) for its Partner: This *Secondary North* One, has the *Primary* One out of the *South* to precede it, and *fill the Bay* pretty full, before it arrive; to raiſe it at leaſt to an *equal* Pitch, with its Competitor; that both jointly may hold the *Water's Equilibrium ſteady*, and the Tide in ſuſpence; while the *Moon* ſtands Neuter, *near the Equinoctial*; as it actually *happens* in the ſaid Port *twice every Month*.

But upon her *Declination* the Tide *riſes*; and if ſhe decline towards the *Norward*, the *Primary Tide*, on that Side of the Equator, being more *enforced* by her Preſſure, makes High-water at her *Setting*: But, repaſſing the Equinoctial *Southward*, the *Secondary North Tide* (which hap'neth at the twelve Hours End) thro' the more favourable Aſſiſtance ſhe gives the *Primary South Tide*, its Aſſociate, on the contrary, *ſhifts* the Tide from her *Setting* to her *Riſing*: And the nearer ſhe approaches to *either Tropick*, the reſpective Tide becomes *more* advanced; and that *One* joint Tide, being *compos'd of all Four*; Two to *Flood* it up into the Port, and Two to *Ebb* it out again; each Flux and Reflux muſt continue *twelve Hours apiece*; which

give

gives a juſt and full Account of the *whole* Appearance.

Such have been the *various* Phenomena of he Tide, thro'out the *Ocean*, according to my beſt *Information*, as I have deſcribed; yet *o one* of 'em has thwarted the Doctrine I ave deliver'd upon that Subject, in the leaſt: And ſo much they have been *diverſify'd* by he occurring *Coaſts* and *Shores*, and their *In-ts* within Land; that, upon ſight, they ap-ear'd univerſally *Anomalous*, in ſome reſpect r other; yet ſtill have fairly accorded with he Principles I have here laid, and the Uſe have made of 'em: But as for their *Paucity*, r *Plurality* in any Arms of the Sea, I found *ne* that appear'd, upon ſight, ſo *odly* extra-agant as the *Euripus*, and the *Port at Tunkin*; or any that prov'd more ſuited to my Pur-oſe, and *regular*, upon a due *Examen* of all eir Circumſtances, thro'out the Univerſe.

SECT. VII.

f the various Floods and Currents, *found in the* Magellanick Streight, *of the* Boſphorus, *and at* Gibraltar; *Their ſeveral* Cauſes; *and the* Manner *how they are occaſion'd.*

INCE I have ſhewn already, what Tides have been occaſion'd in the *Gulphs* ſeveral *Seas*, by their Floods poſting thi-er *thro' Streights* and Paſſages, *differently* af-ting them: It now occurs farther to demonſtrate,

monſtrate, what Floods and *Currents* are found in [illegible] *Streights*; when they mediately conjoin as *different Seas*; as, 1. Either Two External Oceans; 2. Or Two *Inland Seas*; or elſe, 3. One of the *one Sort* with another of the *other*.

It is generally obſerv'd, that the *Stream* which moſt conſtantly affects any of thoſe Streights, ſtill *deſcends* from a higher Situation to a lower: Hence it is, that the *Anian* and *Molucca Streights*, which, in the *North*, conjoin the *Pacifick* with the *Tartarian*; and in the *South*, with the *Indian Ocean*; as alſo the *Magellanick Frith* does the *Ethiopick* with the *South Sea*; all three Currents *deſcend Weſtward* from Oceans *rais'd* and puſh'd forward by an *Eaſterly* Wind, into a *lower* Water: As, on the contrary, the Stream, at *Gibraltar*, deſcends into the *Eaſtern Mediterranean* Sea, drain'd *lower* than the *Atlantick Ocean*, by the ſcorching Beams of the Sun; and the *Boſphorus* deſcends from the *Higher Euxine* (ſwell'd with the *Danube*, *Boriſthenes*, *Tanais*, &c.) into the *Lower Archipelago*, which receives not a proportionate Recruit.

Now, as to thoſe *Streams*, or *Currents* which are peculiar to the Streights of every Sort; and, for Brevity's ſake, to ſingle out *One* of each Kind, which is moſt *remarkable* for the great Diverſity of their Floods:

Firſt, The *Magellanick Streight*, which conjoins the *Ethiopick* and *Pacifick Oceans*, beſides its *conſtant Stream* into the *Weſt*, has alſo a *Tide* that ſets in with it, which riſes and falls every *ſix Hours*, with about *twelve Minutes* Interval, as in other Seas : And a *contrary* Tide, from the *Pacifick*, falls into the Mouth of it at the *Weſt End*, which contracts itſelf *narrower* towards the *Eaſt*, for *thirty Leagues* together ; 'till the *Gulph* become ſtraiteſt, and the *oppoſite Floods* grow ſharpeſt, when they chance to re-encounter near it.

So that the *Paſſenger*, to render this Gulph *Navigable*, avoids the falling in with *their Occourſe*, where the Streight is *narroweſt* ; by taking the *Firſt* of his Tide, to bring the Veſſel into it, and carry her thro' it, before ſhe meets with the *Adverſe Flood* ; that the Channel becoming *re-enlarged*, (the One being not too much contracted, nor the Other relax'd,) their occurring Streams may *ſwell up gently* into calm and ſmooth Water : ſo that, if a brisk Gale favour the *Ship's deſign'd Courſe*, ſhe may bear up againſt the Stream, either to the *Eaſt* or *Weſt*, ſo as to make the *Voyager's Paſſage* quick and ſafe : Inſomuch that the good Succeſs of ſome, who *Timed* and *Tided* the Shooting this *Gulph* aright, have diſcredited the *diſmal Reports* of others, as feigned and fabulous.

But, Mr. *Dampier* found 'em much otherwiſe ; who tells us, That after his Ship was run into the Mouth of *Le Mair's Streight*, (which is near the *Magellanick*, but much leſs difficult and dangerous) " They found a
" ſtrong Tide, *ſetting* out of the Streight to
" the *Northward*, and like to *founder* the Ship ;
" but whether Flood or Ebb, they knew not ;
" only it made *a ſhort cocking Sea*, as if it had
" been a *Race*, where two Floods met, for it

" ran *every Way* : Sometimes breaking in over
" their *Waſte*, ſometimes over their *Poop*,
" ſometimes over the *Bow*, and the Ship *toſs'd*
" like an Egg-ſhell ; ſo that they never felt
" ſuch *uncertain Jerks* in a Ship : And belike
ſhe fell in with the *occurring Floods*, where the
Paſſage was ſtraiteſt.

Secondly, As to the *Boſphorus*, which, tho' it be a Streight between two *Inland Seas*, without any Connexion with the *Ocean*, or Dependance on its Tide; yet 'tis obnoxious to as great a *Diverſity of Currents*, which proceed from *different* Cauſes.

1ſt, Concerning that *Current*, out of the *Euxine Sea* into the *Archipelago*, from *North* to *South*, it neceſſarily *deſcends* by the Propenſion of its own *Weight* (having neither Wind nor Tide to drive it); and conſequently it deſcends from a *higher* Station, to a *lower*; the *Euxine* overflowing the *Archipelago*, as being in Proportion repleniſh'd and *ſwell'd* by the *Danube*, *Tanais*, *Boriſthenes*, &c. more plentifully than the *Mediterranean Sea*, which exceeds it at leaſt thrice its Compaſs.

2dly, Whereas the ſaid Stream is but *ſix Foot* deep, and floats upon a *contrary one* out of the *Archipelago*, which *preponderates* it, as is found by ſundry *Experiments* ; 'tis no more a Wonder, that it *floats* upon the Surface of the *Adverſe* Current, than that *Oil ſwims* upon the Surface of other Liquors.

3dly, Nor is it more ſtrange, that the *Salter* and conſequently the *denſer* and *heavier*, Water of the *Archipelago*, ſhou'd force its Way *under* the *Euxine Stream*, into the *North* by its

Pro-

Preponderation (which is *freſher* and *lighter*, and ſo leſs able to *reſiſt* it): And the nearer it ſinks to the *Bottom*, ſtill it becomes more *ponderous*, and enabled to *preſs forward*, in Proportion to its Weight upon a deeper Deſcent; eſpecially about the *Middle* of the Channel, where the *Counter-floods* have Liberty to expreſs the Energy of their *Height*, and *Weight*, to the greateſt Advantage.

Finally, if it be true, as is reported, that the *Two Coaſting Currents* of this Streight, run *counter*; that, on the *Weſt* Side, towards the *South*; while the other on the *Eaſt*, returns into the *North*; it is no more than *ordinarily* happens, when the *freſh* and *ſalt* Floods [being diverted at the *Entrance* into any of our *Ports*, each apart to the *contrary* Side, by ſome latent *Rock*, or oblique *Bank of Sand*]; the one comes *in*, and the other goes *out* at the ſame Time; paſſing by each other *diſtinguiſhably*, perhaps for *a League* together: So in our preſent Caſe, the *oppoſite* Mouths of the *Boſphorus*, being diverted *ſeveral* ways, direct their *Coaſting Currents*, the one towards the *Euxine*, and the other towards the *Archipelago*, after the ſame Manner.

Thirdly, The *Atlantick* Tide, which ſets into the *Mediterranean Sea*, thro' the *Streight of Gibraltar*, ſwells the Stream which tranſmits it thither, and lets it fall *alternatly* at every *ſix Hours* End; with an Interval of *twelve Minutes*, like the *Magellanick Gulph*; and both are devolv'd together, down *the Middle* of the Channel; while each precedent Flood returns, by *Reſult*, from the *Bottom* of the *Le-*

vant ; partly reſtored by *Libration*, and partly re-enforced by the *Encreaſing* Preſſure of the *Southing Moon*, to refund on each Side a *Coaſting Current* into the *Ocean*, whence it came ; as the *Boat-man*, where he cannot ſtem the *Middle* Stream, follows the *Bank* to find calmer Water.

And, that this *Secondary Reſulting* Tide, may reach the Height of the *Primary* one (beſides the *Moon*'s aforeſaid Re-enforcement), the joint *Inclination* of the oppoſite *Shores*, up to the *Streight's Mouth*, concurs to *unite*, and proportionably to *raiſe* the Height of that Tide, which was before *dilated* and *lower'd* all the way, from *Sicily* (the *Axe* of its *Libration*) on each Side of the *occurring* Stream; ſo as to refund part of their borrow'd Water, into the *Ocean* itſelf ; 'till the undiſtinguiſhable *Union* of all *three* Floods in *one*, ſufficeth to re-advance ſtill *another* reſulting Tide, to an *equal Height* with the former, which immediately preceded it.

Thus the Diurnal Courſe of the *Moon*, drives the Tidal Tumour with Ups and Downs, of *ſix Hours apiece*, from the Bottom of the *Streight's Mouth*, to the Point of *Gibraltar*, *Eaſt* and *Weſt* ; and the *Weight* of her Preſſure being advanced, in Proportion to the *Height* of her Advance towards the *South* ; the ſaid Tumour muſt *ſwell* moſt, at the Places that extend *fartheſt North* ; as at *Venice*, in the Bottom of the *Adriatick* ; and at *Marſeilles*, in the *Gulph of Lyons* ; where it ſwells *a Foot*, whereas it bears up elſewhere, ſcarce *ſix Inches* : But her Advance lying between *Eaſt* and *Weſt* all the while, the yielding Tide muſt be driven towards *N. W.* and reſult from *N. E.* on the *Spaniſh Shores*, for Inſtance ; and run from *C. Frangerola* into the *Streight's Mouth*, at *South-weſt*, as is found by the *Pilot's Obſervation* : And, ſince he has furniſh'd us with a very accurate *Account* of the ſeveral Motions of the *Tide* found therein, 'twill not be amiſs to have their ſundry Appearances *farther examin'd*, and fully diſcuſs'd.

SECT. VIII.

A more particular Account *of the Tide, in the* Streight of Gibraltar, *from Experience and Reaſon.*

TO give my ſaid *Account*, an unqueſtionable Aſſurance ; 1*ſt*, I produce for it, as to Matter of Fact, our *Engliſh Pilot*'s Obſervation, in his own expreſs Words: 2*dly*, In regard the *Streight's Mouth* contains *Five* ſundry Streams, which paſs thro' it out of the *Atlantick* Ocean, into the *Mediterranean* Sea ; I delineate 'em to the Eye in a *Map*, exactly the ſame with his : And, 3*dly*, Foraſmuch as their Currents differ no leſs in Point of *Time* ; I extract their Periods alſo, out of his *Tide-Table* : only abridge, as to the Diurnal Courſe of the *New-Moon* Tide ; and begin, as he doth, with the Deſcription of that, which is peculiar to *C. Tariffe* and *Tangier* ; and the only one, that flows out of the *Eaſt*.

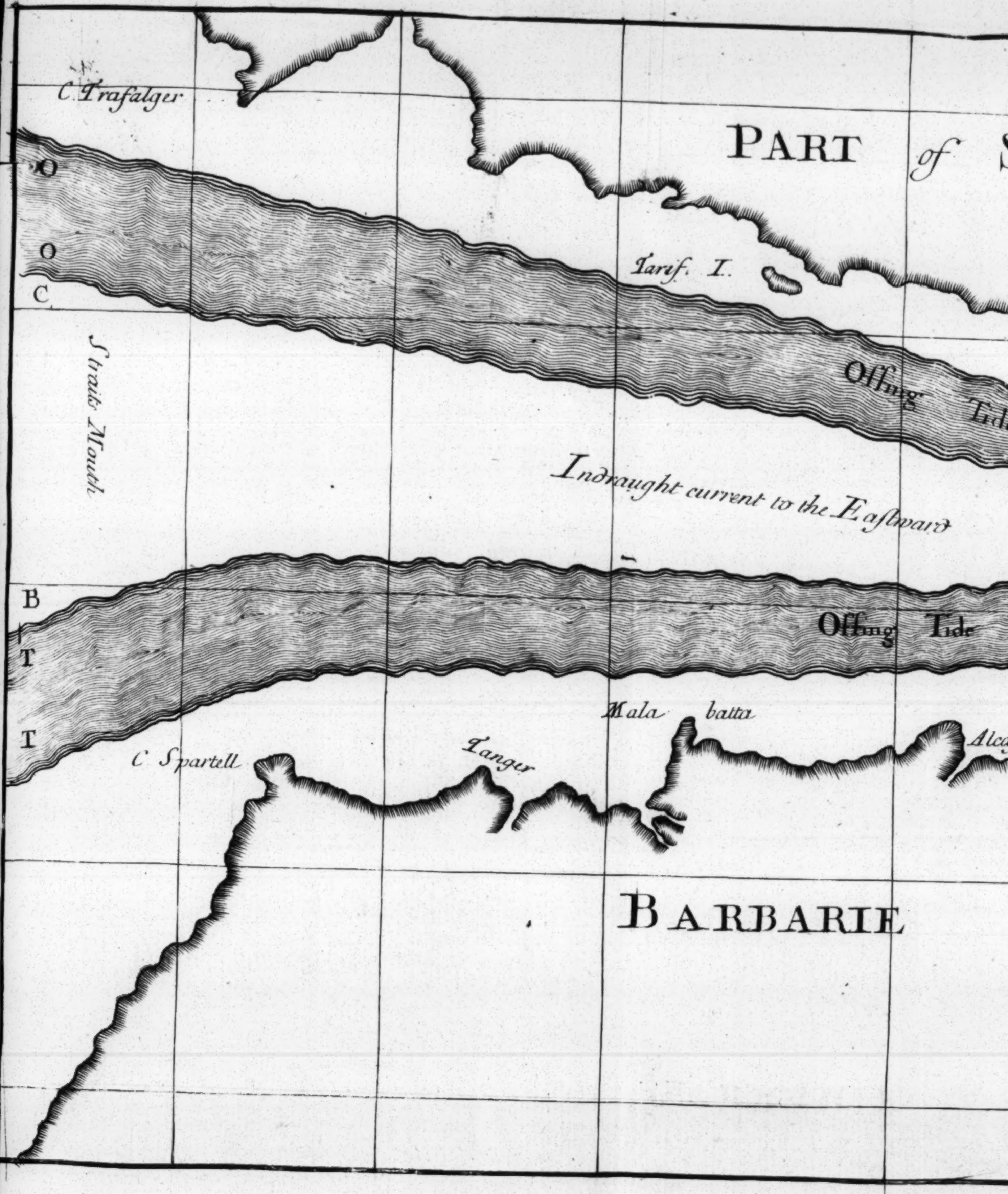
The

The Pilot's *Obſervation, of the Tide in the* Strei of Gibraltar, *is as follows*, viz.

“ At *Tangier* and *Tariſſe*, a *S. W.* by
“ Moon maketh full Sea, at II $\frac{1}{4}$, on the *Sh*
“ but in all Parts of the *Streight's Mouth*,
“ Flood runs until a *W.* by *S.* Moon, or V
“ All the other Parts of the Streight's Mo
“ have Flood out of the *Weſt*, which run
“ from C. *Spartel*, and C. *Trafalgar*, on e
“ Side, along by the *Shore*, much ſtron
“ than in the *Middle*; to the *Eaſtward*, as
“ as C. *Cabrita* on the *Spaniſh* Side, and *A*
“ *Hill* on the *Barbary* Side; and at theſe T
“ Points, meets the Flood that cometh
“ of the *N. E.* about the *Point of Gibral*
“ and runs *S. W.* into the *Streight's Mouth*,
“ the firſt quarter Flood; and the Rem
“ der of the Tide, the Flood *ſetteth* from
“ *Point of Gibraltar*, *W. S. W.* towards C.
“ *brita*.

“ At the *Top* of High-water, there com
“ always out of the *Weſt*, between the
“ *Capes*, a Race of a Current, which ſpr
“ eth the *whole* Streight's Mouth, from
“ to Side, but continues on neither ſel
“ longer than *half an Hour*; but in the *M*
“ of the Streight's Mouth, the Current ru
“ the *Eaſtward* very ſtrong, *all* the Ti
“ Ebb; and the Race of a Current, *f*
“ always between *Ape's-Hill*, and C. *Ca*
“ at a *W.* by *S.* Moon; and at *that Inſtan*
“ gins the Ebb, on the *Weſt* Side of thoſe
“ Points, to run to the *Eaſtward*.

“


C. Trafalger
PART of S
O
O
C
Straits Mouth
Tarif. I.
Offing Tid
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Tanger
Alc
BARBARIE

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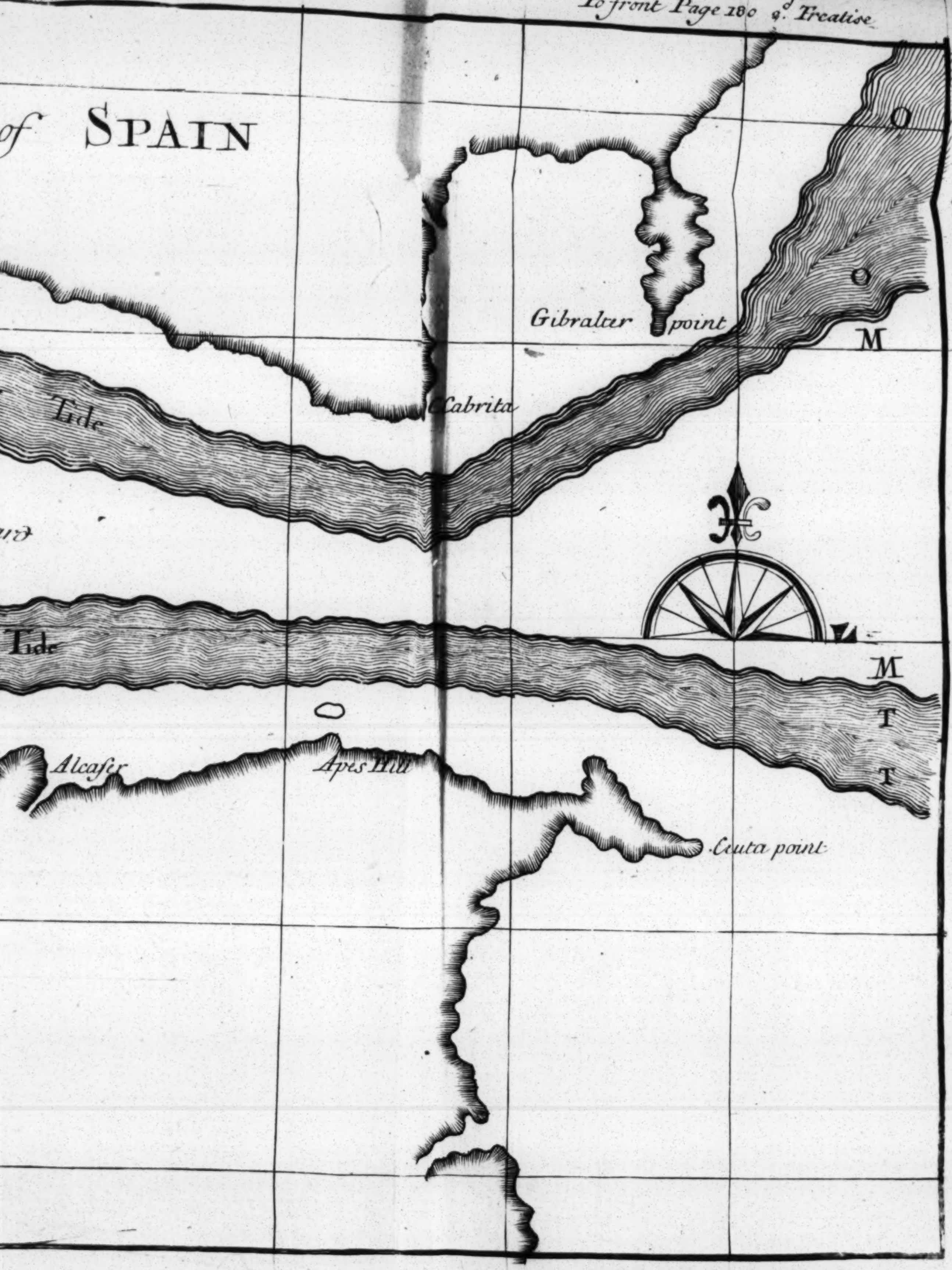
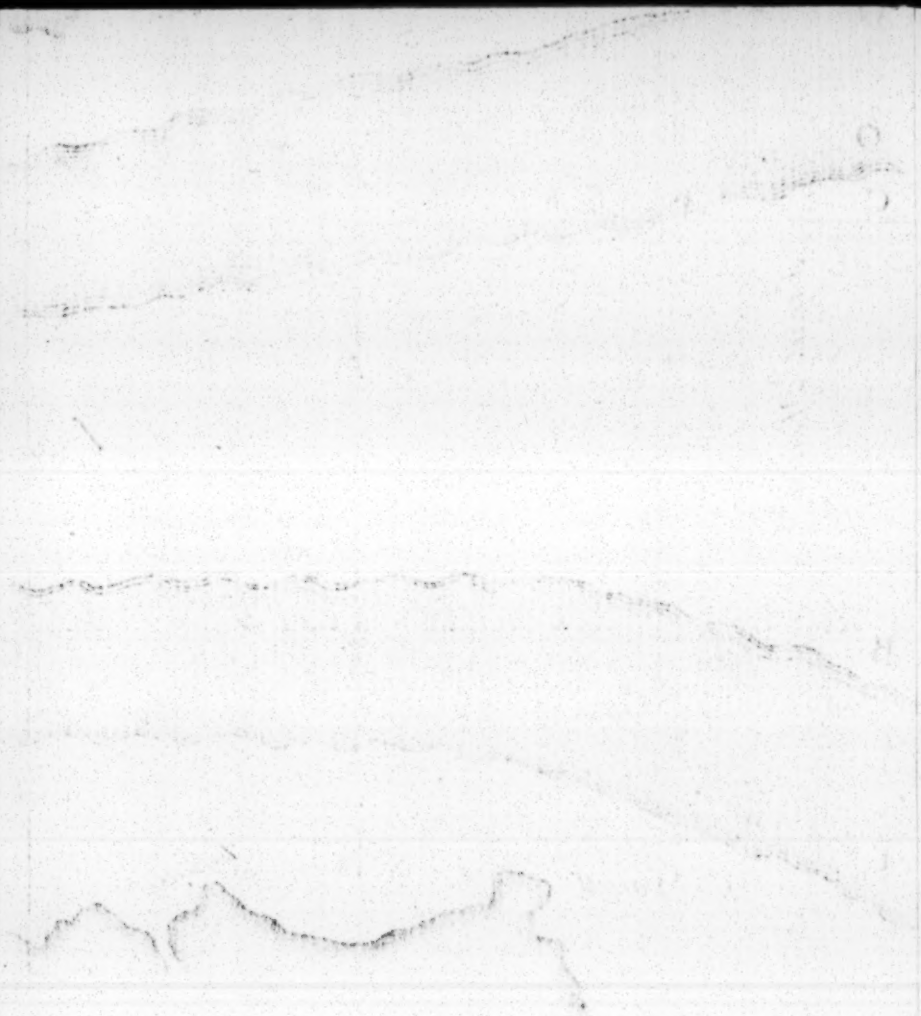




“ The Tide of Ebb, on the *Spaniſh* Coaſt,
“ runs from *Cape Cabrita*, about two Leagues
“ broad from the Shore, as far as the
“ *Iſland of Tariffe*; and runs between the
“ Iſland and the Main, all the Tide of Ebb,
“ along by the *Shore*, towards *Cape Trafalgar*;
“ but on the *South* Side of the Iſland, the
“ Ebb runs very *narrow*, except it be in a Set
“ of fair Weather.

“ The Tide of Ebb, on the *Barbary* Side,
“ runs from *Ape's Hill* but narrow along the
“ *Shore*, as far as the *Point of Alcaſar*; but, on
“ the *Weſt* Side of the Point, thwart of the
“ *Bay*, the Tide runs about *three Miles broad*;
“ and at the *C. Malabata*, which is the Eaſtermoſt
“ Point of the *Bay of Tangier*, about
“ *two Miles* broad; and ſo continues to the
“ *Weſtward*, out to *C. Spartel*; and from
“ thence, the Ebb runs *S. W.* along the Shore,
“ towards *Salley*.

“ The Ebb, to the Eaſtward of *C. Cabrita*,
“ and *Ape's Hill*, is begun by the foreſaid
“ Race of Current, which *ſpreadeth* from
“ the one Side to the other, between *Gibraltar*
“ and *Ceuta Point*, and runs in E. N. E. in
“ the *Middle*; from the Point of *Ape's Hill*
“ to the Point of *Ceuta*, along the *Shore*, all
“ the firſt half Tide; and the remaining
“ half Tide, the Current runs from *C. Cabrita*,
“ E. S. E. into the *Streight's Mouth*, by
“ the Point of *Ceuta*; and from the Point of
“ *Gibraltar*, the firſt half Ebb runs *N. E.* into
“ them, towards *C. Frangerola*.

Thus far the *Pilot's* Obſervation.

X The

The *Pilot*'s Delineation of the *Streight's Mouth*, with regard to its five-fold Tract of *Currents*, is as I have deſcribed in the aforegoing *Map*: Now, to inſpect his Table of the Tides, for the *Periods* of their Floods and Ebbs, upon every Line; *Firſt*, From the Line B, to the *African* Shore, the Tide begins to Flow *Eaſtward*, at 10^h; and Ebbs to the *Weſtward*, at 4^h: And from the Line C, on the *Spaniſh* Coaſt, it begins to Flow to the *Weſtward*, at 11^h; and to Ebb alſo to the *Weſtward*, at 5^h; yet, between the Offing Lines T T on the one Side, it Flows not to the *Eaſtward*, 'till 1^h; and Ebbs not to the *Weſtward*, 'till 7^h: And between the Offing Lines O O on the other Side, it begins not to Flow to the *Eaſtward*, 'till 2^h; nor Ebbs to the *Weſtward*, 'till 8^h; while the *Middle* Current ſtill Flows to the *Eaſtward*, at near the ſame Height, without Intermiſſion.

Seeing therefore all theſe Floods and Ebbs, are ſtirr'd up, and let fall again, by the ſame Flux and Reflux of *one ſingle* Wave, or Tumour of the Sea, yet no Two of either Sort, begin to riſe or ſubſide at the *ſame Time*; the Queſtion is, how they become ſo *differently* diſpos'd, to reſent its Impulſe?

Firſt, The *Coaſting Streams*, which firſt receive its Influence, are beſt *diſpos'd* for that purpoſe; as having no ſpecial *Inclination* of their own, to reſiſt it; nor *Depth* of Water, for any to be impreſs'd into; but, Floating upon ſhallow and *ſhoaly Bottoms*, are eaſily ſtirr'd, and as ſoon appeas'd, like *ſhallow Lakes*, upon every Wind that blows, or Calm that ſhall happen ; and ſo muſt take the *firſt* Notice of any Commotion.

On the contrary, the *Middle Current*, having *Fall* enough to direct its Flux to the *Eaſtward*, and Channel of *ten Leagues* to continue it the ſame ; having alſo *Depth* of Water to rowl forward, and the *Atlantick Ocean*, to keep it ſupply'd to its full Height : Without Impediment of Coaſt, or Shore, to *deflect* its Courſe, or *leſſen* it Speed, muſt ſuffer no Dependence on the *Moon*, to hinder its Precipi- ation.

But the *Offing Floods*, interpoſing between he two Extreams, muſt *partake* of both theſe Extreams, by their mutual Coherence ; the *nconſtancy* of the one, ſo as to Ebb and Flow y Lunar Influence ; and withal the *Steadi- eſs* of the other, not to be wrought upon ver-haſtily ; but, as it is *three Hours later*, in ceiving the Tidal Impreſſion ; ſo to pre- rve it as much *longer* ; but yet as all theſe ifferent Motions being regulated, by the ide's *ſix hourly* Revolution ; ſo at every ſix ours End, to make, by a timely Ebb, Re- itution. And,

Firſt, The *Pilot* obſerves, that the *Coaſting ream*, on the *Spaniſh Side*, that begins to ow at 11^{h}, and ſhou'd continue ſo 'till 5^{h}, akes High-water *at Tariffe* an Hour and half oner : *2dly*, That the Coaſting Tide, near e *African Shore*, which begins to Flow at 10^{h}, d ſhou'd Ebb at 4^{h}, continues running 'till : *3dly*, That the *Offing Floods*, which be- n not to ſwell 'till 1^{h} and 2^{h}, and ſhou'd ow 'till 7^{h} and 8^{h} ; yet fall with the gene- Ebb, between *C. Cabrita* and *Ape's Hill*, at 5^h: *Laſtly*, That the Tide from the *N. E.* both Flows and Ebbs to the *Weſtward*, out of the *Mediterranean* into the *Atlantick*, whoſe Situation muſt be *higher*, to give the *Middle Current* the quite contrary Motion: Now, to reconcile the *Pilot's Calendar*, to his *Obſervation*; and both to Truth, in the Points aforeſaid;

Concerning the *Firſt* Point; to wit, That the Tide which came from the *N. E.* and *began* to Flow at 11^h, and boldly enter'd the *Streight's Mouth* to *S. W.* at the dead Ebb, for the firſt Quarter of its Flood; ('till the Remainder was deflected from the *Point of Gibraltar*, to *W. S. W.* by the Springing *Weſtern* Tide, towards *C. Cabrita*, and thence to *Cap* *Tariffe*); made High-water there, at $2^h\frac{1}{2}$ that is, two Hours and an half before 5^h When, according to the *Pilot*'s Tide-Table, it ſhou'd have begun its Ebb: *Anſw.* But th Sea was *Full* at half Tide there, in regard th *Coaſting Channel* was ſtraiteſt; and withal a *Iſland* was objected to its Courſe, when i Flux was briskeſt, and had Water enough t *reſult*, at its firſt Appulſe, *higher* than th Stream was able to maintain, after the Energy of that Puſh was over; tho' it continue to Flow afterwards, to its full Time.

The ſame Tidal Tumour that came fro the *N. E.* makes alſo Full Sea at *Tangier*, o the oppoſite Coaſt of *Barbary*, near the ſam Time; having paſs'd from *Ceuta Point*, b *Ape's Hill* and *C. Alcaſar*, as far as *C. Malabat* where the Coaſt moſt *ſtraitens*, and Roc *oppoſe* it; and withal, the *Weſtern* Flood o

cu

curs, to ſwell it as high at *Tangier*, as it roſe before at *Iſle Tariffe*; yet with this difference, that the Tide of Ebb continued its Courſe to the *Weſtward*, beyond *C. Trafalgar*; whereas this *Eaſtern* Flood is born to the *Eaſtward* whence it came, by the *Current* out of the *Weſt*; before it reach *C. Spartel* towards the Ocean, to compleat its ſix Hours Ebb.

Secondly, It is obſerv'd, that the Coaſting Tide, on the *African* Side, which begins to Flow at 10^h; and has but 'till 4^h, allow'd it to its Ebb by the *Tide-Table*, yet continues running to the *Eaſtward*, 'till 5^h at leaſt: *Anſw.* That the *Firſt* of the Tide, is carried to the *Eaſtward* ſo far, by the *common Current* out of the *Weſt*; while the *hinder End* of its Flood is upon an Ebb, after the ſaid Allowance is expired: As Sea-floods in *freſh Rivers*, Ebb near the Sea, while they Flow to the Landward, at a greater Diſtance.

Thirdly, That the *Offing Floods*, which begin not to ſwell 'till 1^h and 2^h, in the Afternoon; and ought to Flow 'till 7^h and 8^h, at Night; yet Fall, between *C. Cabrita* and *Ape's Hill*, at 5^h in the Evening; with the general Ebb of the *Weſtern* Flood, in all Parts of the *Streight's Mouth*, at once: *Anſw.* Notwithſtanding, they continue their Flux to the *Eaſtward*, to their ſtated Terms of *ſix Hours* apiece, though they cannot re-advance the Tide to that *topping Height*, it had before; and they return not their Stream of Ebb, 'till it be withdrawn by the Tidal Reflux of the *Ocean*; which ſet it on foot *ſo late*, and was as long in *withdrawing* it Motion; which was done with equal Difficulty both ways, and conſequently muſt be perform'd in the *ſame Space* of Time.

Fourthly, That the aforeſaid *N. E.* Tide, both Flows and Ebbs, along the *Spaniſh* Shore, perpetually to the *Weſtward*, quite contrary to the *Middle Current*, which runs without any Tidal Ups and Downs, as conſtantly to the *Eaſtward*; and conſequently from the Higher Situation of the *Atlantick*, into the Lower of the *Mediterranean Sea*; which ſeems to render the contrary Motion of the Tide impoſſible: *Anſw.* To make thoſe oppoſite Flux's conſiſtent, it ſufficeth that the *Mediterranean Flood* advance above the *Atlantick Ebb*, to convert their Courſes: Nor does the Flux of the *Middle Current* intermit, at Low-water, nor exceed when it is higheſt in the *Atlantick*, but obſerves the *Mean* betwixt 'em: As the *Spout* of a *Pump* keeps to a conſtant Stream, tho' the Water in the *Tube* riſe and fall at every Stroak, *ten* or *twelve Inches*; yet the *Side* Streams, ſometimes *exceed* the Speed of the *Middle* Current, between *C. Cabrita* and the *Congreſs-height*: Hence it is obſerv'd,

Fifthly, That the Tidal Flood out of the *Weſt*, runs more ſtrongly from betwixt *C. Trafalgar* and *C. Spartel*, than the *Middle Current*; which obſerves a *Mean* between the higheſt Flood, and the loweſt Ebb; and follows the Shores of *Spain* and *Barbary*, 'till it meets the *N. E.* Flood, between *C. Cabrita* and *Ape's Hill*, where they *Counter-ſwell* each other, 'till the Water be full thro'out the *Streight's Mouth* (*Tariffe* and *Tangier* excepted) 'till 5^h; that the *Atlantick* Flood, which made High-water on the Promontories of *Ireland*, *France* and

Spain, at 3^h; and fill'd their *Ports*, at 4^h; now reacheth the Bottom of the *Streight's Mouth*, and fills all full, at 5^h; and bears down the *Eaſtern Ebbing*, which damm'd up their Paſſage thitherwards, all the while: 'Till,

Laſtly, As this Univerſal Deluge came from *all Parts*, and chiefly from *E.* or *W.* with a Point or two of *N.* or *S.* ſo, after the Top of the Tide, has broken down the Rampire of the Tumour, that withſtood it; a general Puſh is made to the *Eaſtward*; yet, after *half an Hour* is over, it Ebbs every way at once, from the Topping Height: The *Middle* flows *Eaſtward*; the *North* Stream, towards *Gibraltar*; and the *South*, to *Ceuta Point* with Freedom, without any *Deflection* for the firſt Half-Tide of Ebb: But the *Remainder* is driven by the *N. E.* ſpringing Flood, by degrees tranſverſly, *thwart the Mouth* of the Streight, from *C. Cabrita* to *Ceuta Point*; to *end* this Tide, with the *beginning* of the next, and perfect the Circle.

The *Pilot*, having finiſh'd his moſt accurate *Obſervation*, gives us a Caſt of his *Office*; by directing, how to turn thro' the *Streight's Mouth*, the Wind being *Weſterly*: *viz.* To ply to the Windward on the *Spaniſh Side*, from the Point of *Gibraltar* to *C. Cabrita*, and from thence to *Iſle Tariffe*: And, having *Tided* two or three ſhort Boards up to the Windward, a little before High-water, and the Race of Current out of the *Weſt*, the Ship is to be *Anchor'd* there, 'till ſo much of the Tide be ſpent, as to get over to the *Barbary Side*; and take the Tide of Ebb, as to fall to the *Weſtward* of the *Point of Alcaſar*, that ſhe may get into the *Bay of Tangier*, by a Low-water; and obſerving the Tide, may turn at Pleaſure.

So eaſily are reſolv'd the *Doubts* and *Difficulties*, ariſing from the *various Tides and Currents* of thoſe Friths and Streights, that interfare between Seas of all Sorts; particularly the *Magellanick*, the *Boſphorus*, and that of *Gibraltar*; which, for the *Multiplicity* and *Contrariety* of their Fluxes, ſeem to include and explicate all the reſt: Only certain *Miſtakes* remain to be rectified, concerning the *Cauſes of Whirlpools*, found in ſome Seas; and of *ſubterraneous Rivers*, fancied to be in others; and both upon *weak* Grounds, and for *impracticable* Uſes, as ſhall be demonſtrated in the enſuing *Section*.

SECT. IX.

Of Whirlpools, *ſtirr'd up in the Sea; their Dependance on the* Tide; *and,* how *they are occaſion'd.*

SINCE the whole Courſe of the Tide is *progreſſive*, and *direct*; as far as the Obliquity of tranſverſe *Coaſts* and *Shores* permits: It occurs to enquire, How ſuch a *circular Whirling* of Water can be ſtirr'd up, even in the *Ocean* itſelf, by its Means; and for what *Uſe* it may ſerve? And to direct our Enquiry, 'twill not be amiſs to conſult thoſe Eddies in *Brooks*, and *Rivers*, which much reſemble 'em nearer home; and examine, *how* they are made to the Bottom; which may be done as good cheap, and with leſs Labour.

Firſt, To ſtir up ſuch *Whirlpools*, as every ſmall Rill is capable of; it is requiſite, that the Current which produceth it, be, in part, *deflected* by ſome Bank of Sand, Gravel, *&c.* into a ſhelter'd adjoining *Pool* of calmer Water; where it has Liberty to *wheel about* its crooked Confinement, 'till it rejoin its own Stream, where it began to circulate: But falling within its former Compaſs, its Revolutions ſtill become more and more contracted, *ſpirally*, and they terminate at laſt, *Periwinckle-like*, in the *Center* of their Circumgyration; whither it carries all its *Wreck* of Straw, Leaves, *&c.* to turn *around their own Center*, without End or Limit; and the like happens in *Rivers*, and Arms of the *Sea*, where the freſh or ſalt Floods meet with *Shores*, or *Shelves*, which are apt to turn and wind 'em into *Gulphs*, and *Whirlpools*, of a larger Extent.

Secondly, It is to be noted, that *Sands* and *Shelves* under Water, as effectually cauſe the aforeſaid *Deflection*, *&c.* as the *Banks* and *Shores* do above it; and, by the Crookedneſs of their Channels, *inflect* the Sea-Currents into *ſpiral* Circumvolutions; ſo that the incumbent Surface of the Sea-water, *wheels about*, and is revolv'd *circularly* whence it came, in compliance with the Streams *underneath*, by their mutual Coheſion, as aforeſaid: Thus the *Effect* is patent, tho' the *Cauſe* be concealed; as well in the *Ocean* itſelf, as in our *Rivers*, or Arms of the *Sea*, according to the ſeveral Situations of the *Bottoms* they move upon.

Thirdly, It is obſervable, that, while the Brook, or River wherein they are found, continues *riſing*, the *Whirlpool* flows higher about its *Circumference*, than at its *Center*; and when it *falls*, on the contrary: As other Streams are *higher*, at the Place whence they actually flow, than whither they finally tend: Hence it is, that *Flowing*, they gather the Wreck to their *Centers*; and when they *fall*, diſperſe it: So the *Whirlpool*, for the ſame reaſon, while the Tide flows, *attracts* thoſe Ships into its Center, which fall within the Compaſs of its *Spires*; by letting 'em deſcend all the while, 'till they be *overſet* and ſwallow'd up; which, upon its Ebb is *caſt up* again, and ſcatters their Wrecks around over the Sea, by a *contrary* Revolution.

Fourthly, To make this Appearance more *remarkable*, it is to be noted, 1*ſt*, That *Flowing* Streams are of a *Convex Superficies*, ſo as to be protuberant in the Middle; and *Falling*, they become *Concave*: Hence it is, that the Flowing Tide, makes the Surface of the Ocean to appear *raiſ'd*; and the Ebbing, to be as much *depreſs'd*; which makes the *Whirlpool* ſeem to *ſink* into the Sea, at the one Seaſon, and to *riſe* out of it again at the other: 2*dly*, Since flowing Streams cannot *ſtop* on a ſuddain, the *Whirlpool* riſeth longer, than the Impulſe of the Current drives it: 3*dly*, The Channel which conveys it, being wider at its *Entrance*, than after 'tis *ſpirally contracted*; it muſt needs raiſe its *Center* much higher, than the *Circumference*.

Two ſuch *Gulphs*, as I have deſcribed, lie too near us to queſtion their Exiſtence; the one, in our *South Channel*, near *Normandy*; and the other is that famous one in the *Ocean*, upon the Coaſt of *Norway*; both which draw Veſſels *ſpirally* into their Cavities, by the Help of the *Flowing* Tide; and when it *Ebbs*, return 'em back again from their Protuberances, either *broken* or *whole*, by the ſame vertiginous Tracts; That, upon the Coaſt of *Normandy*, reſtores 'em to their former Liberty, *ſafe* and *ſound*; by gently unfolding thoſe *Spires*, which invol'd 'em before: But that other near *Norway*, daſhes 'em to pieces upon the *Rock*, in the Middle of it, and ſcatters their Wreck all the Sea over; without *ſwallowing* 'em down in Gulphs, or *Rivers under-ground*; or caſting 'em up again, as is commonly apprehended.

Hence plainly appears, that no Conſequence can be drawn, from the alternate *Riſing* and *Falling* of thoſe Gulphs, that they hold a Correſpondence with others of the ſame Nature, *under-ground*; which *ſupplies* 'em with Water, when they want it; and *takes it off* again when they abound, by *ſubterraneous* Cavities made for that purpoſe: But, as a *Spout*, falling obliquely into a *Tunnel*, contracts alike a *Whirling* about its Brink, whether the Pipe underneath be *ſtop'd*, or *open*; ſo do theſe Gulphs, without any ſuch *ſubterraneous* Communication, put on as *diverſe* Appearances, by *ſwelling* or *ſinking* alternately, in all Places; and *rejecting* viciſſitudinariouſly, what they had *attracted* before.

SECT. X.

A more particular Account of the Vortex, *or* Whirlpool *on the Coaſt of* Norway; *and,* how *it is cauſed in every reſpect.*

TO exemplify what I have ſaid already, of the Nature and Production of *Whirlpools* in general, by the Recital and a farther Diſcuſſion of *this,* on the Coaſt of *Norway:* In order to infer, that *ſubterraneous Aquæducts,* are no more required to produce 'em in the *Ocean* itſelf, than in *Brooks,* and *Rivers,* where no ſuch Supplies can be pretended; to deal impartially between them, (ſince the Diſparity muſt lie, in the Diſproportion of the *Cauſe,* to the *Effect*): *Firſt,* I produce, in behalf of the *Effect,* the *Deſcription* given of it, in the *Grammar of Geography;* which aſſerts; that, in all Probability, the ſaid *Whirlpool* is occaſion'd, by ſome mighty *ſubterraneous Hiatus:* And, on the contrary, to give the *Cauſe* its due Force, and Application, I expoſe it to the View of *Senſe,* as well as *Underſtanding;* and exhibit the Place *Where,* and *How* that Pool is ſeated, according to Mr. *Moll's Map of Europe;* only *enlarged,* to ſhew what Advantage the Tide makes of the *Situation* thereof, to give the Water its *Whirling* Motion; agreeable to the Account already given of it, in the precedent *Section:* Take here, the ſaid

DESCRIPTION, *Viz.*

" Upon the Coaſt of NORWAY, near the " *Iſle Hitteren*, in the Latiude of 68, is that " remarkable and dangerous *Whirlpool*, com" monly call'd MAOLSTROOM, and by Naviga" tors the NAVEL of the *Sea*; which *Whirl" pool* is, in all Probability, occaſion'd by " ſome mighty *ſubterraneous* HIATUS, and proves " fatal to *Ships* that approach too nigh, pro" vided it be in the Time of *Flood*; for then " the Sea, upwards of *two Leagues* round, " makes ſuch a terrible VORTEX, that the Force " and *Indraught* of the Water, together with " the *Noiſe* and Tumbling of the Waves upon " one another, is rather to be *admired* than " *expreſs'd*: But, as in the Time of Flood, " the Water is *drawn in* with a mighty Force; " ſo, during the Tide of Ebb, does it *throw " out* the Sea with ſuch a Violence, that the " heavieſt Bodies, then caſt into it, can't " ſink; but are *toſs'd back again* by the impe" tuous Stream, which ruſheth out with in" credible Force: And during that Time, is " abundance of Fiſhes caught by *Fiſher-men*, " who watch the Opportunity; for, being " *forc'd* up to the Surface of the Water, they " cannot well dive again, ſo *violent* is the " riſing Current.

Seeing therefore the aforegoing *Deſcription*, is ſo far agreed with my former Account, that *Currents* are the *effective Cauſe* of *Whirlpools*, whereſoever they happen; as to acknowledge, that, in the Time of *Flood*, is made that terrible *Vortex*, that proves ſo fatal to Ships on the Coaſt of *Norway*: And that during the Tide of *Ebb*, the Water is *thrown out* with Violence, that was *drawn in* before; and that is ſaid to be the *Cauſe*, which being put, or taken away, the *Effect* correſpondently followeth, or ceaſeth: The Tide ſtands fair to be the *Cauſe* of the *whirling Motion*, as well on that Coaſt in the *Sea*, as the Currents in *Brooks* and *Rivers*, do of their *Eddies* and *Whirlpools*, of a ſmaller Size.

And if it be doubted, leſt the ſaid *Cauſe* ſhou'd want ſufficient *Power*, or *Application*, to produce ſo prodigious an *Effect*; as that, in all Probability, ſome mighty *ſubterraneous Hiatus* were required, to help it out; the Situation of the *Place*, is to be farther conſider'd; and the foregoing *Map* to be inſpected, to find where the Diſadvantage lies: Which (if *any* were to be found,) wou'd be exhibited to Satisfaction.

Firſt, As to the *Application* of the Tidal Force, on the Coaſt of *Norway*, where this *Whirlpool* rageth; ſince it ſetteth right upon all *open* Shores, from the *Middle* of the Ocean; and theſe of *Norway*, are extended from *S.* to *N.* and lie open to the *Weſt*; the *Weſtern Flood* muſt fall upon this Pool, at the beſt Advantage; as lying ſituated between the utmoſt Points of the *Iſle Ruſt* and *Loſfoet*, which bear *N.* and *S.* to each other: And, in regard the *Weſt* Coaſt of the former *Iſland*, lies extended from *Cape* (a) to *Point* (b) from *S. W.* to *N. E.* for *four Leagues* together; the Declivity thereof, *con-*

tracting

tening the Stream all that way, to a *third* Part, before it touch the ſaid Pool; it muſt be ſtronger and ſwifter, as *three* to *one*; to enforce that *whirling* Motion upon it more powerfully, than the common Stream of the *Ocean*, whence it came; and withal, its Current continuing *five Miles* in *Breadth*, muſt ſupply it with Water more abundantly.

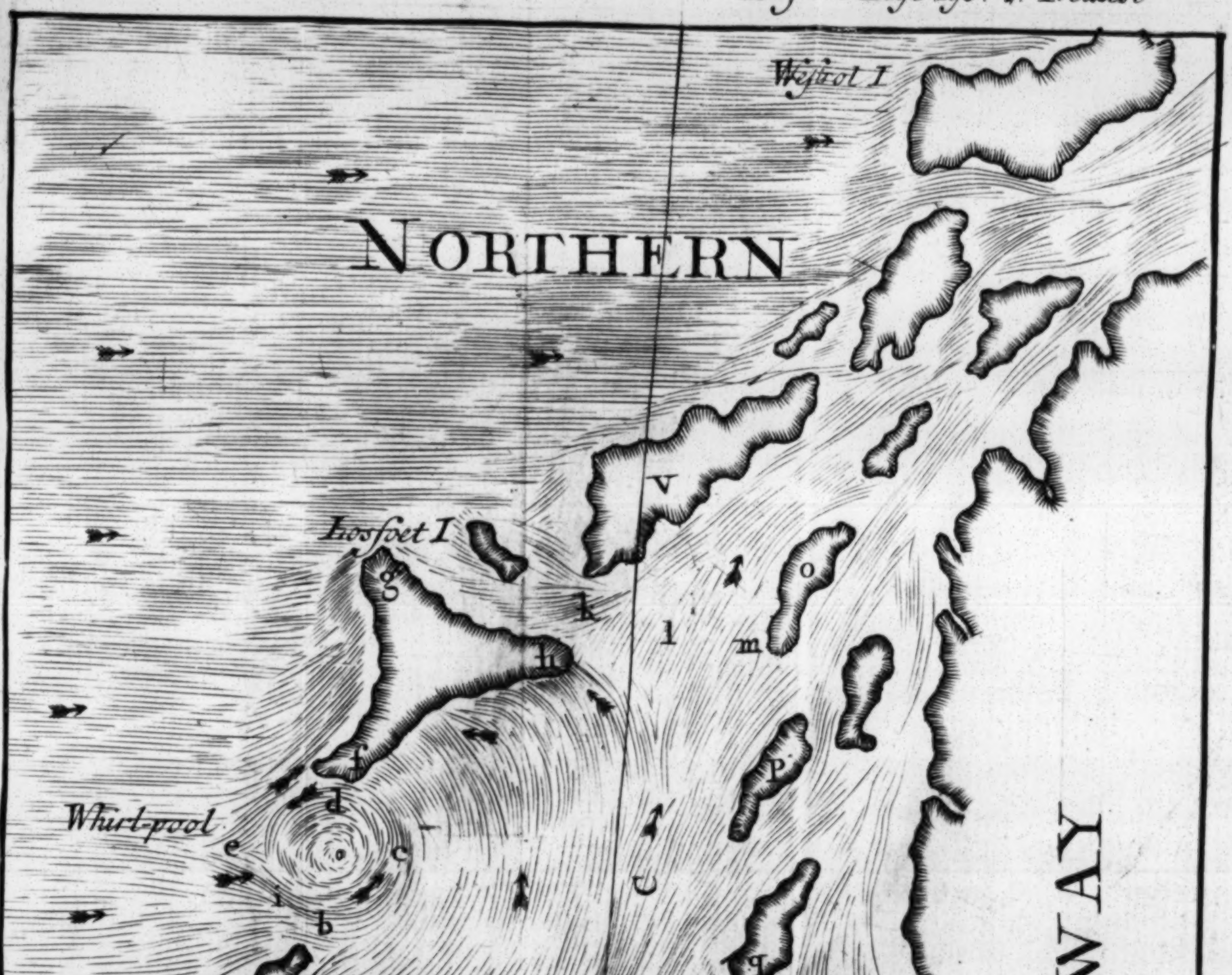
2dly, As to the Point of *Incidence* upon the ſaid Pool at (i), the Stream drives its Motion, on that Side, opportunely thence, from *S.* to *N.* as far as (c); where *this* Tidal *Current*, from (a) to (c), meets with *that* of (A. B. and C.), from the Back-ſide of the ſaid *Iſle Ruſt*; which, with an *oblique* Stroak, diverts it to full *North*: And both their Streams, being *conjoin'd*, are *ſtraiten'd*, and *ſwell'd* up, on all Sides *at once* from the *Eaſtward*, by the *Iſlands* (o. p. and q.); and from the *Northward*, partly by the *Stream* (k. l. and m.); and partly, by the *S. Eaſt* Coaſt of *Losfoet-Iſle*; from *Point* (h) to (f), and their joint Stream is forced thorow the Paſſage *between* (d.) and (f), to the *S. Weſt*, as far as (e), into lower and *calmer* Water; the Tidal Stream out of the *Weſt*, being in part carried off by *Point* (f), into the *Bay* between (f. and g), while their Stream is *drawn* by the other Part of it towards (i. and (b), where the *Circulation* firſt began, and is now perfected.

3dly, This *firſt Circumvolution* of the Tidal Stream, about the Brink of the *Whirlpool*, being finiſh'd; the Flood brings on a *Second* circular Wave, which, by degrees, *ſurrounds* the former; 'till a *Third*, ſupervening, *involves 'em both* within its Compaſs; into which a

Fourth, contracts *all Three*; as the reſt do *ſucceſſively* one another, 'till the inmoſt penetrates the *Center* of their Circumgyration, and puts *a Stop* to that which follows it; and each to other, as ſo many *Rocks*, to break the purſuing Waves; 'till the *laſt*, which flows higheſt, tumbles over *all* the reſt, from upwards of *two Leagues* in Compaſs; with *Noiſe* and Diſorder, beyond all Conceit and *Expreſſion*; the *Navel-Tumour*, towards which they *tend* all the while, ſwelling to a Height extraordinary, during the Time of the *Flood*; which ſtill *repeats* its Impulſe, and furniſheth Freſh-water perpetually, 'till its Flux be over.

4*thly*, The Flood being *ſpent*, and its Impulſe loſt, the Tide of *Ebb*, firſt *withdraws* the *utmoſt* encircling Wave; which lets the *next* Fall after it into the Deep; and the *Third*, after 'em both; and the *Fourth*, afte all; and the reſt *ſucceſſively*, tumble one ove another; 'till the *Central* Tumour (which ſwells all the while), be let fall over *all thoſ* accumulated Ridges of Water, which ſupported it, from the Summit of its *Height* around, to the *Bottom* of the Ebb, with an irreſiſtable Precipitation: So as to *puſh awa* whatſoever is thrown into it, that the *heavieſ* Bodies can ſcarce ſink; and the *Fins* of Fiſhes can no more ſerve 'em here, to eſcape th *Fiſhers* Nets; than *Rudders* can ſteer *Ships* ou of this *Whirlpool*, and ſave 'em from ſtavin in Pieces: So uſeleſs and improbable, ar *ſubterraneous Hiatus's*, found under the Sea, i *this Section*; and as vain and impoſſible, i the *next*.

To front Page 196. 2d Treatise



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SECT. XI.

Of Indraughts *of Water, and* Subterraneous Rivers; *and their Accommodation to Land and Sea.*

THE *Gulphs*, and *Whirlpools*, mention'd in the precedent *Section*, are ſo commonly conceiv'd to be *Indraughts* of Water, holding an alternate Communication with *Rivers*, and *Caverns* fill'd with ſuch Matter, under-ground; that, to go about (as I have done) to diſprove it, ſeems to be a flat Denial, that any ſuch *ſubterraneous Paſſages* and *Receptacles*, are probable: I ſhall, inſtead of that, labour for an Accommocation, by *Replying* to what is uſually urg'd in behalf of their Exiſtence.

Firſt, When it is *objected*, that ſuch *Indraughts* of Water, as the aforeſaid Gulphs are imagin'd to be, are required to keep *Inland Seas* within their Bounds, and to prevent *Lakes* from overflowing; and the *Caſpian* is inſtanced for ſuch; which, notwithſtanding the Confluence of ſeveral vaſt Rivers into it, of which the *Volga* is one of the firſt Magnitude; yet *ſwells not* with its Floods; nor, in the leaſt, reſents the inequality of Rain in *Winter*, above the Drought of *Summer:*

It is *reply'd*, that, in regard all thoſe *Rivers* drain no more Ground by their Floods, than the *Caſpian* watereth with its Vapours; it cannot ſpare any Surpluſage of Water, to *overflow* its Shores; nor needs that Sea to ſwell in

Winter, while the *Volga* is frozen up in the *North*; and the Snows are not thaw'd about *Novogorod*, 'till *Mid-April*; and are not diſembogu'd, at *Aſtracan*, into the *Caſpian*, until *Midſummer*; tho' the reſt of the Rivers moſt *abound* with Water, for all that Seaſon: Nor is it to fall in *Summer*, upon ſo vaſt a Recruit, when thoſe Rivers are almoſt *dry'd up*, by the ſcorching Beams of the Sun: So that no ſuch *Gulphs* are required, to keep it up to the ſame Height, at *either* Seaſon.

When it is *alledg'd*, that *Guadiana* finds a *ſubterraneous* Paſſage, *ſeven Leagues* long, to prevent its Inundation of a conſiderable Part of *Spain*; and the *Caſpian* muſt do the like, to paſs off the Streams aforeſaid, perhaps into the *Euxine*, that *Perſia*, *&c.* may eſcape the ſaid Misfortune:

It is again *reply'd*, that the Parity doth not hold, to make good the Conſequence: For, altho' ſuch *Paſſages* be as poſſible, in both Caſes, as it is for *Bridges* to be made, either by Art or Nature; and for Rivers to paſs *under*'em, upon a competent Deſcent; and ſuch an one is neceſſary, in the *former* Caſe; yet it does not appear to be either uſeful, or practicable in the *later*: For Firſt, the *Caſpian*, being of equal Extent with our *Great-Britain*, and lying as far *South* as *France*; to *expand* thoſe Streams, and *expoſe* 'em to the ſcorching Beams of the Sun; ſeems *ſufficient* to reſolve 'em into Vapours, and prevent its Overflowing: Nor is it probable, that the *Euxine Sea* lies *lower* than the *Caſpian*; ſince the ſaid Rivers run a *longer* Courſe, and require a *greater* Deſcent, than any in *Europe*: Beſides, *Spain* has leſs need of ſuch a *Lake*; being, on *three Sides*, ſurrounded by the Sea; than the *Nations* bordering upon the *Caſpian*, at *ſeven hundred Leagues* diſtance from it: But wonderful is the *Divine Providence*, and faithful to his Promiſe; to water a conſiderable Part of *Africk* with the Flood of *Nile*, like a Garden; and a no leſs Compaſs of *Aſia*, by the Vapours extracted from the *Caſpian Lake*, with the Dew of Heaven.

And whereas is *urg'd* the Neceſſity of ſuch *ſubterraneous Currents*, out of ſome Seas into others, which wou'd otherwiſe prove ſuperfluous, and unaccountable: *Anſw.* As is miſtakingly conceiv'd of the *Coaſting Stream*, on the *South* Side of the *Mediterranean*, which follows the *Barbarian* Shore, from *Gibraltar*, *Eaſtward*, as far as *Aleppo*, without any Return: And of the *Current* on the *Weſt* of the *Adriatick*, which runs perpetually *Southward*, along the *Calabrian Coaſt*, as far as it reaches: For theſe (as I have already ſhewn) are only Currents, that make *Reſtitution* for the Tidal Tumours, that follow the *oppoſite Channels*, which circulate into each other: But what is worth the *Remark* is, that the *ſubterraneous Conveyances* of Water, which are ſuppos'd to paſs out of theſe Seas into any other, are abſolutely *impoſſible*; the *Adriatick*, lying on the ſame Level with the *Mediterranean*, which lies lower than the *Ocean* itſelf, that flows into it without Intermiſſion.

Yet upon ſuch Surmiſes as theſe, ſome *Authors* fancied the Earth to be an *Animal*, which ejected the Tide, and ſwallow'd it down again by *Reſpiration*, thro' bottomleſs *Gulphs*, and *Indraughts* of Water, reported to be found in *ſome Seas*; yet ſo rarely, and with ſo *little Effect*, even upon the adjacent Shores, that they cou'd no more be thought to influence the *common Courſe* of the Tide, around the Univerſe; than that the Flame of a *Candle* might ſuffice to illuminate a whole Nation: But, perhaps thoſe Authors only pretended to *fancy* ſo, for an Eſſay of *Wit*, to try whether this Opinion (as *abſurd* as it appears) was not as defenſible, as any of the reſt that were ſtarted, about the Cauſe of the Tide; to turn all their Search after it into a *Jeſt*.

No leſs vain and groundleſs are the Imaginations of thoſe, who ſtill frame to themſelves ſuch impracticable Exiſtences, as *ſubterraneous Rivers, &c.* without any juſt Occaſion; or even a Poſſibility to be made other Uſe of, than to diſcourage their Followers, from ſearching into the *true* Cauſes, of the Subſtance of the Tide; or any ſuch Appearances of it, as theſe odd Fancies are pretended for; and to drive 'em into an utter *Deſpair* of ever arriving to any ſolid Satisfaction, in any ſuch Matters: And in the mean time, they ſerve their *Authors* themſelves, as often as they chance to fall upon any *Difficulty*, which they cannot tolerably explicate, for Subterfuges to conceal their *Ignorance*, and Starting-holes to make their Eſcape.

SECT. XII.

A Recital *and* Explication *of ſuch Inſtances of the various Motions of the Tide, which ſeem to be the moſt unaccountable.*

TO begin (for Method's ſake) with thoſe Tides, which immediately affect the *Ocean* it ſelf; where the Influence of the Moon's Preſſure finds the leaſt Reſtraint from any Interruption by *oppoſite Coaſts* and *Shores*; and thence proceed briefly in order to the reſt, as behoves a Rehearſal:

The *Firſt* Inſtance, which is ſuggeſted to frame this Order, is, that at *Cayen* under the *Equator*, the Spring-Flood makes not High-Water 'till the *fourth* Hour after the Moon's *Southing*; nor 'till the *ſixth*, after ſhe has paſs'd the Great *Meridian*; and conſequently, ſhe had made an *Ebb* at their Interſection, by the Preſſure of her Preſence, juſt when it was *Flood* upon the *ſame Meridian*, within the *Temperate Zone*: *Expl.* Which is quite contrary to the common Opinon; (*viz.* That it is Flood and Ebb in *both* Places *at once*) but exactly agrees with Matter of Fact, and the foregoing Doctrine.

Secondly, It is no leſs wonder'd at, that the Flood upon that *Iſland*, ſhou'd ordinarily riſe no higher than *ſix Foot*; and the Spring-Tides never exceed the reſt, above *ſix Inches*; eſpecially lying ſo near the Congreſs of the *Ethiopick*, and *Atlantick* Floods, upon the *Equator*: *Expl.* But it is leſs ſtrange, in regard they arrive not *thither* at the *ſame Hour*; ſo that that which comes *firſt*, carries off the Stream of the *later*, before it can mount to the Height, which is ordinary in other Places.

Thirdly, The *Ethiopick* Flood is deſcribed to come with much more Violence out of the *South*, towards the *Line*, than the *Atlantick* does from the *North*: *Expl.* And there is good Reaſon for it; ſeeing the *former* is dilated from the *Cape of Good Hope*, to the *Magelanick Streight*; and becomes ſtill more contracted, by the inclining Shores of *Braſil* and *Congo*, to enforce it all the while; whereas the *later* ſpreads itſelf to a greater Breadth, along its Paſſage from our *Britiſh* Coaſts, 'till it reach the *Equator*, and becomes weaken'd as much, by its Expanſion.

Fourthly, 'Tis obſerv'd, that it advanceth not to the ſame Pitch, at the *Tropicks*, that it doth upon the *Equator*, on the *one* Side; or in the *temperate Zone*, on the *other*: *Expl.* Becauſe the *Tropicks* are the *Axes* of the Tide's *Libration*; and ſo it muſt riſe and fall to its full Extent, at *each End* of its Reciprocation; while the *Center*, whereon it moves, remains fix'd and ſteady.

Fifthly, 'Tis obſerv'd, that 'tis High-water at once, on both the *Eaſt* and *Weſt* Sides of the *Atlantick*, in the ſame Latitude; as on the Coaſts of *New-England* in *America*, and of *Poitoü* in *France*; after three Hours Ebb in the Middle, and ſo long Abſence of the Moon from the Great *Meridian*: *Expl.* Becauſe the Tide had departed each Way, from it, towards the *Eaſt* and *Weſt*, to the like Diſtance, in *equal* Spaces of Time; or elſe the parted Floods had been as different, both for Height and Time; as the Tides at the *Canaries* are (which lie *nearer* to that Meridian) both ſtronger, and come ſooner thither, than thoſe at the *Caribees*, on the other Side of the *Atlantick*; becauſe they lie farther diſtant from its *Center*, which is their common Source.

Sixthly, Mariners find, more to the *Northward*, a ſtrong Flood at *Hudſon's Bay*, and a very weak one on the Coaſt of *Norway*: *Expl.* Inaſmuch as the *former* opens its wide Mouth *immediately* to the Great *Meridian*, its common Tract; whereas the *later* declines it no leſs to the *Eaſtward*; and lies more remote, to the *Northward*, from the Courſe of the Moon, which ſhou'd enliven it.

Concerning the *different* Influence of her Preſſure upon our *narrow Seas*, and *Lakes*; ſome have no Tide at all, as the *Caſpian* and *Euxine* Sea; for want of Communication with the *Ocean*; beſides, they have neither Extent, Figure, nor Situation, proper for that Purpoſe; whereas ſome *Lakes*, which are wholly ſequeſter'd from all Commerce with the *Sea* (are reported to be in the *North America*, of which *Two*) having Extent and Situation proper for it, Flow and Ebb, periodically, by the Moon's ſole Influence, twice in twenty-four Hours; tho' they ſometimes intermit, or elſe reach not their uſual Height, as is aforeſaid.

And as for the *Baltick* and *Mediterranean* Seas, which lie open to it; the Tide of the

Ocean, being almoſt ſpent in the *German* Sea, before it reacheth the Sounding; the *former*, as lying too far *North*, to be influenced by the Moon's Preſſure, looſeth the Tidal Effect: And the *later*, which lies at a more convenient Diſtance, partaking it with Accommodation; it moſt abounds where it has moſt Liberty to rowl towards the *North*; as at *Marſeilles*, in the *Adriatick* Gulph, and the *Levant*.

Nor is it more ſtrange, that the ſame Flood ſhou'd riſe fifty Foot at *Hull*, Sixty at *Briſtol*, and Seventy at St. *Malos*: In regard that at the *Firſt* Port, our *South* and *North-Britiſh* Currents redouble their languiſhing Forces, by their mutual *Occurrence*; at the *Second*, the *Severn-Sea* gapes with ſo wide a Mouth, to drink in the Ocean; and ſwallows it down ſo *narrow* a Gullet, to raiſe the Tide to a Height extraordinary; and at the *Laſt*, the *Bay*, with a ſtretch'd-out Arm, takes in near a *third Part* of our *South Channel*, and brings it almoſt to a Point at St. *Michael's Sea*, to exalt it above the reſt.

And in regard the River *Garrone* can contain *two* Floods at once, having a ſtreight Channel, with Length, Breadth, and Depth, capable of 'em; we need not wonder, that *four* Tides ſhou'd be kept on foot at once, in the Sea, at much *farther diſtant* Places; as at the *Equator*, *Plymouth*, *Hull*, and *Amſterdam*; ſtill purſuing one another, at twelve Hours diſtance, as it were from *four* ſeveral *Stages*, upon the ſame Road.

As for *Supernumerary* Tides, which happen *oftner* than twice every twenty-four Hours, in the ſame Place; they are occaſion'd by a *Diviſion* of the common Tide, paſſing into the ſame Gulph of the Sea, thro' *diſtinct Channels*; and of ſo unequal Speed, that the one may Flow and Ebb, before the other arrives; as ſometime happens in our *Iriſh Sea*, thro' its *South* and *North* Channels out of the Ocean.

And in caſe a *Second* Gulph ſucceeds the *Firſt*, and the Channels conducting 'em thither, *ſubdivide* the *Four* Floods already made, as it happens in the *Euripus* behind the *Negroponte*, to make 'em up *Eight*; if *One* be withdrawn within that Space of twenty-four Hours, as it happens there by the Moon's Abſence, only *Seven* muſt remain: ſo on the contrary, the Cauſes of the Tide's Multiplication being *revers'd*, an equal *Re-union* muſt follow; ſo that *Four* Tides may be conjoyn'd into *Two*, and theſe *Two* be re-joyn'd into *One*, by acting Counter to each other, (as in the Port at *Tunkin*) by their different Application.

Laſtly, Whereas it is obſerv'd, that the Courſe of the Tide rather adheres to the *Mean* Motion of the Moon, than to either of the *Extreams*; 'tis becauſe the *Ocean* which is mov'd, conſiſting of a ponderous, as well as voluble Element, muſt ſtill hold to its own Pace; like a long *Pendulum*; which more regards the *equal Poiſe* of its own Weight, than the *unequal Draught* of the Clock, which keeps its Swinging on foot.

And whereas the Swings of the Tide moſtly continue to *riſe higher*, for ſome Days, after the *Change* and *Full*; as *January* is moſtly colder than *December*, and *July* hotter than

June, after the Sun has left his higheſt and loweſt Stations: 'tis becauſe, in all three Caſes, the *active Power* of the Sun and Moon decreaſeth leſs than the *paſſive Reſiſtance* in the Subject Air and Water doth, to hinder the Encreaſe of the Effect.

So fully are reſolv'd the diverſe Appearances of the Tide, in all *Seas*, *Rivers*, and *Lakes*, within the Compaſs of our Acquaintance: and doubtleſs the Reſt, thro'-out the Univerſe, ſo far ſympathize with ours, as to be reſolvable upon the ſame Grounds, with equal Satiſfaction: And altho' the Matter thereof, being *phyſical*, may ſeem to include Obſcurities; yet the Form, which is Local Motion, ſtirr'd up by *Truſion*, properly belongs to *Mechanical* Conſideration, which admits no Doubt, when the Matter of Fact is manifeſt to Senſe and Experience. Hence it is to be inferr'd, that the *active Power* of the Sun's and Moon's Preſſure, being proper to raiſe it; and the *paſſive Diſpoſitions* of all thoſe *Seas*, *Rivers*, and *Lakes*, adapted to receive it's different Impreſſions, in the Places aforeſaid; the Effect muſt needs follow, as to its Subſtance, upon their due Application. Tho' in what Meaſure (the Ocean, whence it firſt ſprings, being unfathomable; and the Air, which conveys it, how compreſſible not yet known,) be left ſomwhat uncertain.

SECT. XIII.

The CONCLUSION:

Wherein the Modern Doctrine of Attraction, *and its Fitneſs to explicate the* Phænomena *of the* Tide, *is conſidered.*

HAving in the preceding Chapters deliver'd my own Thoughts concerning both the Cauſes and Effects of the *Tide*, as far as I could find them warranted by Obſervation and Experience, the beſt Guide of Speculation: I thought to have ſhut up my whole Diſcourſe with the brief Recital and Explication of ſuch *anomalous Motions* of it, which ſeem'd the moſt unaccountable; without engaging my ſelf in any Controverſy, or medling at all with the different Sentiments of others.

But this grand Principle of *Attraction*, which ſo ſucceſsfully has been made uſe of, by the moſt celebrated Philoſophers of this Age, in ſolving ſome of the abſtruſeſt and moſt important *Phænomina* of Nature, being apply'd to this alſo of the *Tide*; makes it neceſſary, before I put an end to this Treatiſe, to ſubjoyn ſome few Reflections on its Sufficiency to produce the deſired Effect, as well as its Agreeableneſs with conſtant Obſervation and Matter of Fact.

And *Firſt*, Whereas it is confeſs'd on all Hands, that the *Moon* has a much greater Share in raiſing the Tidal Tumour, than the

Sun, which far exceeds her in Magnitude, purely with Regard to her greater *Vicinity* to the Sea: To argue conſequently upon the ſame Grounds of *Attraction*, it muſt be concluded, that our *Terreſtral Globe*, thro' the great Advantage of its Bulk, (its Maſs of Matter being to her's, nearly as 26 to 1) and its cloſe Approximation to the Ocean, muſt, by a juſt Computation, be much more enabled to *reſtrain* the ſaid Tumour, than the Moon's Attraction can poſſibly be to *raiſe* it.

2dly, To make *two* Floods diametrically oppoſite to each other with one diurnal Revolution: we have ſhewed; how the *Riſing* Moon gradually depreſſeth the Sea into an Ebb, between the *Tropic's*, 'till her Southing: The Water ſo depreſs'd correſpondently advancing all the while *two* Floods, collaterally beyond 'em, upon the *ſame Meridian*: Each of which, by falling, in the next ſix Hours, into an Ebb, fetcheth itſelf up, by *Libration*, upon the *Equator*, to the *ſame* Height, at her *Setting*: And ſix Hours after, returns at Midnight, by *Counter-libration*, to the *ſame* Point whence it firſt came; to counterpoſe, at 12 Hours end, the Flood, which is rais'd by her Preſſure with the *Antipodes*; both hap'ning, in diametrically oppoſite Points, at the *ſame* Inſtant. And the like *Contrapoſition* muſt be concluded of all the Floods and Ebbs within or without the *Tropics* reſpectively. But now to make High-Water in both Places at once, by one ſingle Draught of *Attraction*; maugre its Reluctance, and the Water's *Centripetal* Tendance, joyntly hindring its being rais'd on the contrary

Side; and this without calling in the Aſſiſtance of Tidal *Libration* and *Reſtitution*, to continue a *Counter-motion* in all Places, and at all Times reſpectively, ſeems to me inconceivable.

3dly, Beſides the Conſonancy of this Succeſſion of Ebb and Flood (by *Libration* and *Counter-libration*) to the Laws of *Statics*; it gives, moreover, but little or no Diſturbance to the *Sea* or *Navigation*: For, in regard the *Riſe* of the Tide above the Ocean's common Level, near the *Equator*, ſcarce exceeds ſix Foot, as has already been obſerv'd; and its Ebb's *Depreſſion* ſinks only ſo much below it; and their Riſe and Fall beyond the *Tropics*, can be no more than anſwerable thereto: And again, the Motion of the interpoſing Sea, to ſupply the Extremes, is ſtill proportionate: Hence, no part of it needs move faſter than about 6 *Foot* from its Fellow in 6 *Hours* Space; the whole Body of the Ocean's Water moving together at the ſame *ſlow* rate: So *little* Diſturbance doth the Tide give to the *Sea* itſelf, or Impediment to *Navigation*, in either reſpect; whereas *Attraction*, by drawing the Surface of the Sea toward the *Equator*, and letting it fall back again toward the *Poles*, reciprocally; cauſeth ſuch a progreſſive Determination in it, as muſt needs put the *Ship* quite out of her Road, at ſo vaſt a Rate, as to render the Art of *Navigation* impracticable. Add to this, that the Figure of the Earth being ſuppos'd that of an *oblate Sphæroid*, and its Diameter toward the *Poles* ſhorter than toward the *Equator*; the Water of the Ocean, rais'd by the Moon's *Attraction* be-

between the *Tropics*, wou'd deſcend by its own Weight, after the Force of that Attraction was over, with a Degree of Acceleration proportionate to its Acceſs toward either *Pole*; which muſt occaſion yet farther Inconvenience to the Sailor.

4thly, The Moon's Courſe holding perpetually between the Tropics, or near unto 'em; the Force of her *Attraction* ſhou'd draw the Flux of Tide conſtantly that Way; and withall, ſhe paſſing ſucceſſively from one Meridian to another, it ſhou'd reſpectively attend her thither: Beſides, the Lines of her *Attraction*, the ſhorter and more perpendicular they grow, their Operations ſhou'd become the more powerful; and the farther the Flood follows its Draught, the higher it ſhou'd be advanc'd; whence it muſt needs follow,

1ſt, That the proper Tendence of the Tide ſhou'd drive it from *Eaſt* to *Weſt*, and its Waves be ſtill more accumulated to the *Weſtward*; whereas Experience tells us, that the Mariner ſuffers not the leaſt Drift of his Ship that way, ſave by the *Trade-Wind*, which floats on the Surface of the Water; whilſt the Tide dives into the Deep, and keeps its Stages in the Ocean, under Water, *North* and *South*, without the leaſt Impediment to his Voyage.

2dly, That High-water ſhould always attend the Moon's Motion, from *Eaſt* to *Weſt*, around the Globe; and that it ſhou'd be Flood every where, when ſhe is actually preſent upon the Meridian of the Place: Whereas, it has been made appear, by divers Inſtances, in the foregoing Treatiſe, that it is conſtantly both High and Low-water *at once* under the ſame Meridian, tho' in far diſtant *Climates*; that is to ſay, Low-water between the *Tropics* and the *Equator*, while the Moon is actually preſent there, to ſtoop it by her Preſſure; when it is High-water between the *Tropics* and the *Polar Circles*, under the ſame Meridian, by way of *Reſult*, at a farther Diſtance from her.

3*dly*, It muſt alſo follow hence, that it ſhould flow higher at the *Tropic of Cancer*, being more South, than at the *Streights* of *Gibralter*; and at the *Caribees*, which lie moſt *S. Weſt*, than in any other Part of our *North Atlantic*; quite contrary to all Obſervation.

At leaſt, higheſt Water ſhou'd conſtantly happen *where* the *firſt Meridian* interſects the *Equator*, *when* the Moon is actually near the ſame Point, to give her attractive Power the beſt Application: The Subject Ocean, being *there* equally diſpos'd to receive the Effect, by the greateſt Liberty of Sea-room poſſible to produce it: Yet on the contrary, *there*, and *then* is found the loweſt Ebb: as has been proved from the beſt Accounts of *Navigators*, and their *Tide-Tables*.

Laſtly, Altho' it cannot be denied, that the Tidal Tumour may be cauſed by *Allevation* as well as *Depreſſion*, as has been already noted; Yet, in regard, *Attraction* is no other than an *occult Quality*, whoſe Operation being unexplicable from any of the known Laws of Motion, (eſpecially by ſuch who maintain the Neceſſity of *Vacuities*) is to be reſolv'd merely into the Omnipotent Will of God; and therefore much leſs accountable for than

TRUSION, which is viſible to the Eye, and tractable by the Hand: I hope I may obtain a more eaſy Pardon from thoſe excellent Perſons, who in the Earneſt Purſuit of Truth, have been led into a different Sentiment; if in this Matter I have had Recourſe to *Preſſure* alone: which is manifeſt. to Senſe; whoſe Effects are undeniable; and which anſwers all the *Phænomina* of the Subject I have endeavour'd to explicate.

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